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PRESENTED

BY THE

AMERICAN INSTITUTE

OF THE CITY OF NEW-YORK, TO

Pres't F. A. P. Barnard LL.D.

PRESENTED

TO

THE UNIVERSITY OF TORONTO

BY

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NEW YORK

OCTOBER 21ST, 1890

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Annual Report
OF THE
AMERICAN INSTITUTE

OF THE

City of New York

FOR THE YEARS

1870-71.

Albany
The Argus Co., Printers.
1869.

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THIRTY-FIRST ANNUAL REPORT

OF THE

AMERICAN INSTITUTE,

OF THE

CITY OF NEW YORK,

FOR THE YEAR 1870-71.

ALBANY:
THE ARGUS COMPANY, PRINTERS.
1871.

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STATE OF NEW YORK.

No. 111.

IN ASSEMBLY,

April 4, 1871.

American Institute,
New York, *April 4th*, 1871.

To the Hon. William Hitchman,
Speaker of the Assembly of the State of New York:

Sir. — I have the honor to transmit, herewith, the Thirty-first Annual Report of the American Institute of the city of New York, embracing an account of its transactions for the year ending in April, 1871.

With great respect, I remain
Your obedient servant,
SAMUEL D. TILLMAN,
Corresponding Secretary.

AMERICAN INSTITUTE.

OFFICERS AND COMMITTEES—1871.

TRUSTEES.

President,
WILLIAM B. OGDEN.

Vice-Presidents.
CHARLES P. DALY,
ORESTES CLEVELAND,
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Recording Secretary,
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Corresponding Secretary.
SAMUEL D. TILLMAN.

Treasurer,
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WILLIAM H. BUTLER,
J. GROSHON HERRIOT,
CHAS. WAGER HULL,
GEORGE TIMPSON,
JAMES KNIGHT,
THOMAS RUTTER,
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E. S. DICKINSON,
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JAMES K. SACKETT,
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WILLIAM BURDON,
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STEVENSON TOWLE,
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WILLIAM COLLINS,
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COMMITTEES.

ADMISSION OF MEMBERS—James H. Drake, George Randall, John W. Chambers, Stephen R. Krom, J. W. Richards.

FINANCE—Thomas M. Adriance, Cyrus H. Loutrel, Charles Chamberlain, Simeon Baldwin, J. A. De Lamater.

LIBRARY—Dubois D. Parmelee, John E. Gavit, John B. Rich, Edward Curtis, Edward Schell.

REPOSITORY—M. M. Livingston, Albro Howell, L. Bradley, Frank A. Butler, C. Williams.

MANUFACTURES AND MACHINERY—Charles E. Emery, George H. Babcock, Wellington Lee, Frank L. Pope, Robert Weir.

CHEMISTRY, MINERALOGY AND GEOLOGY—Charles F. Chandler, Dubois D. Parmelee, Julius G. Pohlé, J. S. Newberry, H. Morton.

OPTICAL SCIENCE—John B. Rich, John E. Gavit, John Frey, T. d'Oremieulx, J. J. Higgins.

CIVIL ENGINEERING AND ARCHITECTURE—William J. McAlpine, Robert G. Hatfield, John W. Ritch, Samuel McElroy, Edward S. Renwick.

AGRICULTURE—Nathan C. Ely, John Crane, P. T. Quinn, F. M. Hexamer, Josiah H. Macy.

HORTICULTURE—William S. Carpenter, Benj. C. Townsend, John Henderson, Isaac Buchannan, Joseph B. Lyman.

COMMERCE—J. V. C. Smith, William Dean, Robert Craighead, S. J. Macy, John Colvill.

REGENTS OF THE AMERICAN INSTITUTE.

EDWIN D. MORGAN,
GERRIT SMITH,
CORNELIUS VANDERBILT,
EZRA CORNELL,
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SAMUEL F. B. MORSE,
HAMILTON FISH,
HENRY W. BELLOWS,
HENRY WARD BEECHER,
WILLIAM H. APPLETON,
ORLANDO B. POTTER,
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REGENTS EX-OFFICIO.

THE GOVERNOR OF THE STATE OF NEW YORK.
THE MAYOR OF THE CITY OF NEW YORK.
THE U. S. SECRETARY OF THE INTERIOR.
THE TRUSTEES OF THE AMERICAN INSTITUTE.

FACULTY.

SAMUEL DYER TILLMAN, LL.D., Professor of Mechanical Philosophy and Technology.

JULIUS G. POHLÉ, M. D., Professor of Analytical Chemistry.

ROBERT P. STEVENS, M. D., Professor of Geology and Mineralogy.

JAMES A. WHITNEY, A. M., Professor of Agricultural Chemistry.

OFFICERS.

JOHN W. CHAMBERS, CLERK AND LIBRARIAN.
DANIEL R. GARDEN, ASSISTANT CLERK.

ANNUAL REPORT

OF THE

AMERICAN INSTITUTE.

To the Honorable the Legislature of the State of New York:

In presenting the thirty-first annual report of the American Institute of the city of New York, the undersigned beg leave to say, that its Transactions for the year ending in April, 1871, are fully set forth in the annexed documents, containing,

I. A review of the affairs of the Institute, submitted by the retiring Trustees at the annual meeting, held February 2d, 1871.

II. An exhibit of expenditures and receipts during the fiscal year.

III. Annual reports of standing committees.

IV. An account of the business operations of the Board of Managers of the fair, including the list of premiums awarded during the last exhibition.

V. Addresses delivered before the Institute at the Exhibition Building.

VI. Scientific lectures delivered before the Institute at the Academy of Music.

VII. The discussions of the Farmers' Club, including a portion of its extensive correspondence.

VIII. The proceedings of the Polytechnic Association, embracing illustrated descriptions of new inventions, and notes on scientific progress.

IX. Extracts from the minutes of the Photographical Section of the Institute.

Respectfully submitted.

W. B. OGDEN, *President.*
CHAS. P. DALY.
O. CLEVELAND
H. A. BURR.
EDW. N. DICKERSON.
S. R. COMSTOCK.
SAM'L D. TILLMAN.

New York, *April 4th*, 1871.

REPORT OF THE RETIRING TRUSTEES,

MADE AT THE

ANNUAL MEETING OF THE AMERICAN INSTITUTE, FEBRUARY 2, 1871.

In reviewing the financial, industrial and scientific operations of the American Institute during the past year the Trustees find abundant cause for congratulating their fellow members on its continued success and increasing usefulness. Its several subordinate organizations having cognizance of the advancement of science and its application to the arts, as well as of the various improved methods of managing the factory and the farm, have by their regular meetings and discussions evinced commendable zeal and activity. A detailed account of their proceedings will be found in the reports of the several standing committees having charge of these organizations.

Unprecedented success has crowned the labors of the present Board of Managers. The large amount of money received is the best evidence that the exhibition of 1870 was more attractive than any preceding display.

By the annual statement from the Committee on Finance, to be presented at this meeting, it will be seen that the permanent funds of the Institute have been materially augmented during the year by the investment of $32,000 in United States bonds, making the total amount invested in this class of securities $70,000.

The real estate belonging to the Institute on Broadway and Leonard streets, will probably be occupied for another year by the present tenants. They have made material repairs to the buildings, which, as a whole, are now in better condition than at any former period. It has been deemed best to let this property to one tenant and for short terms, in order to be able to give early possession of the premises in case a sale should be effected. The location of this property, in the midst of wholesale warehouses and the convenience of its frontage on two streets, so enhance its value that no difficulty would be found in disposing of it whenever the Institute decides to invest the proceeds of such sale in erecting a structure better adapted to its own occupancy.

To find a central location of ample area and very accessible from all points, on which the Institute might establish its permanent headquarters, has been the constant aim of the Trustees throughout the year; and although they cannot impart any positive information, it is proper to state, they are not without hope that advantageous propositions will soon be submitted for the action of the Institute. In the meantime other considerations lead the Trustees to suggest that early measures should be adopted for the better accommodation of its several departments, all of which have only a temporary occupation of premises from which they are liable to be excluded at the end of each year. The amount now paid for premises used by the Library, Farmer's Club, Polytechnic Association, Photographical Section, the course of scientific lectures, and by the annual exhibition, exceeds $11,000; in addition to this, a large sum is annually expended for the temporary use of apparatus and fixtures. The gross receipts of the last exhibition were $72,000, while the expenses incurred amounted to nearly $51,000. A material portion of this sum would have been saved had the exhibition been held on premises belonging to the Institute. Another potent reason for early action on the question of building is, the Institute has formally announced that it will hold an international exhibition in the year 1876; to provide for which the permanent structure to be occupied by the Institute should be so located that it can be temporarily enlarged.

In obedience to the resolution passed at a recent meeting of the Institute, the Board of Trustees has forwarded to the Congress of the United States a petition and pamphlet relating to the proposed international exhibition in the city of New York, to be managed by the American Institute, under the auspices of the general government. A counter movement, started in Philadelphia four years later than our own, has so far thwarted the Institute as to secure the passage of a bill through the House of Representatives, which transfers the favor of the United States government, first asked for by the Institute, to the proposed exposition at Philadelphia. This action will not deter the American Institute from carrying into effect its original resolution; and as it has never failed in any of its undertakings, all of which have been conducted without external aid, we may fairly infer it will succeed in 1876. Yet it would not undervalue the benefits which would accrue from the proposed international exposition receiving the official sanction of the General Government.

The course of scientific lectures, given under direction of the Board of Trustees, at the Academy of Music, will close during the present week. It embraces well known lecturers, who have not assisted in our previous courses. The lectures have been well attended, and favorably received, and more particularly by a large class of our members who do not avail themselves of other privileges accorded to them. In conclusion, the Trustees feel justified in expressing the opinion, that no other association presents so many advantages and satisfies such a variety of tastes and intellectual wants as the American Institute, in its exhibitions, its weekly discussions, its lectures, its library and its annual volume of Transactions. By this rare combination it has secured the elements of attraction and expansion which are essential to its strength and growth, and which insure its perpetuity.

Respectfully submitted.

HORACE GREELEY,
WILLIAM HALL,
CHAS. P. DALY,
NATHAN C. ELY,
S. R. COMSTOCK,
GEORGE PEYTON,
SAMUEL D. TILLMAN.

February 2, 1871.

REPORTS OF COMMITTEES.

FINANCE.

Receipts and Disbursements of the American Institute of the City of New York, for the year ending January 31, 1871.

Balance in Bank, January 31, 1870		$772 99

RECEIPTS.

Rental of property	$15,750 00	
Admission fees and dues, and from life members	6,242 00	
State appropriation, 1869	2,315 63	
Interest on investments	2,845 50	
From managers of the 38th annual fair, balance	120 96	
From managers of the 39th annual fair	22,000 00	
Miscellaneous sources	104 50	
		49,378 59
		$50,151 58

DISBURSEMENTS.

Taxes and assessment on property	$2,627 15	
Fire insurance and repairs	321 41	
Books, periodicals and binding	855 69	
Rent of rooms in Cooper Union and gas light	2,382 60	
Printing and stationery	140 46	
Freight and expenses—Transactions from Albany	67 86	
Balance course of scientific lectures, 1869 and 1870	504 86	
On account of course of scientific lectures, 1870 and 1871	1,273 25	
Mineral cases and alterations	327 08	
Reporting Polytechnic and Photographical Sections	295 00	
On account of 38th annual fair:		
Medals, medal cases, diplomas, etc	1,344 89	
Carried forward	$10,140 25	$50,151 58

Brought forward	$10,140 25	$50,151 58
Newspapers, advertising, postage and incidental expenses	732 67	
Salaries	4,808 50	
	$15,681 42	
Invested in U. S. 5-20 bonds of 1867, 1868	32,062 50	
		47,743 92
Balance in bank January 31, 1871		$2,407 66

THOMAS M. ADRIANCE,
THOMAS WILLIAMS, Jr.,
SIMEON BALDWIN,
J. DE LAMATER,
CHARLES CHAMBERLAIN,
Finance Committee.

New York, *January* 31, 1871.

ANNUAL REPORT OF THE COMMITTEE ON THE ADMISSION OF MEMBERS.

The Committee on the Admission of Members beg leave to submit their doings during the past year.

They have made eight reports to the Institute, recommending 136 candidates for admission as members, who have all been duly elected, as follows:

March 3, 1870	25
April 7, 1870	12
May 5, 1870	6
June 2, 1870	14
September 1, 1870	48
December 1, 1870	4
January 5, 1871	20
February 2, 1871	7
	136
Reported by the Board of Managers, December 1, 1870, and admitted January 5, 1871	416
Total	552

By the above statement it will be seen that the committee have only acted on the names of 136 candidates, and the committee feel it their duty to call the attention of the Institute to this fact; and while it may be gratifying to the Institute to receive such an addition to its membership yet they believe that more scrutiny should be taken into the character of the applicants, than the Board of Managers can give in the hurry and excitement of the exhibition.

They would respectfully and earnestly urge that an alteration should be made in the by-laws of the Institute, so that the Board of Managers should have only authority to receive applications for life membership on the payment of the regular fee.

They would further suggest, that no candidate should be admitted as a member who has not arrived at the age of twenty-one years.

The following is the number of members belonging to the Institute:

Honorary members		85
Corresponding members		248
Life members	1,397	
Less deceased	256	
		1,141
Annual members		2,133
Total		3,607

JAMES H. DRAKE,
STEPHEN R. KROM,
JOHN W. CHAMBERS.
Committee.

NEW YORK, *February 2d*, 1871

REPORT OF THE LIBRARY COMMITTEE.

The Committee on the Library beg leave to report that the library and reading room have been opened regularly during the past year. and has been the daily resort of many of the members, and also visited by many of our citizens and by strangers for reference.

A number of choice works on science and art have been added, and several important sets made complete.

During the year $855.69 have been expended in the purchase of books and periodicals and binding.

The supplement to the catalogue of books is in manuscript, and it was hoped that the same would have been printed for the use of the members; but in consequence of the services of the librarian and assistant being required in preparing for the late exhibition, the time necessary for its proper preparation and superintendence through the press have delayed its publication, but it will be immediately put into the hands of the printer and completed at as early a day as possible.

The committee take great pleasure in reporting that the books in the library are in good condition, and at no distant day further provision must be made for its accommodation.

The whole humber of volumes in the library at the date of the last report was		9,534
Added during the year by purchase	202	
" " donations and exchanges	44	
		246
Total		9,780

All of which is respectfully submitted.

JAMES K. CAMPBELL,
DUBOIS D. PARMELEE,
EDWARD WALKER,
SAMUEL D. TILLMAN,
Library Committee.

New York, *January* 31, 1871.

REPORT OF THE COMMITTEE ON AGRICULTURE.

The Committee on Agriculture in accordance with the requirements of the by-laws, would respectfully report: That their duties have been confined chiefly to the Farmers' Club; and that during the year the meetings have been held every Tuesday, excepting during the usual August recess, and seldom have the meetings failed to be crowded with an interested audience. Our proceedings are published in most of the agricultural papers, and through the newspapers of this city. Our proceedings are published weekly, and thereby a vast amount of timely reading on the subjects which are discussed by the club are read by millions. The Tribune alone estimates that each week 1,000,000 read the proceedings of the Farmers' Club of the American Institute in that paper; nor can the committee fail to mention the World and the Times, who report at great length each week; also the Sun, Artizan, Independent, and many other papers of this city, and from distant places, have their editor or reporter at every meeting. The proceedings are published in the Transactions of the American Institute, and this obviates a lengthy report. During the year thousands of parcels of flower-seeds, cereals, and choice new varieties of potatoes, grafts, cuttings, grape vines, and strawberry, and other plants have been distributed; and committees from the club have visited Virginia, North and South Carolina, Georgia and Florida, Ohio, Kentucky, Utah, Colorado and California. From each of these States most valuable information was obtained. A number of committees have visited many portions of New Jersey and Pennsylvania with like results. Your committee might go into detail, as to the numerous agricultural implements, which have been tested from time to time, by committees appointed for this purpose during the year; suffice to say, much is done each year to lighten the labor of the tillers of the soil. These committees have not cost the treasury of the Institute a single dollar.

Respectfully submitted.

NATHAN C. ELY,
JOHN CRANE,
P. T. QUINN,
F. M. HEXAMER,
JOSIAH H. MACY,
Committee on Agriculture.

MANUFACTURES AND MACHINERY.

The Committee on Manufactures and Machinery respectfully present the following report:

That at their first meeting, after organizing, they unanimously reappointed Professor S. D. Tillman as Chairman of the Polytechnic Association, fully appreciating his untiring exertions in this important branch of the American Institute; and Robert Weir was elected Secretary of the same. It was also agreed, that a competent and experienced technical phonographic reporter was needed, who, in addition to the full reports of the proceedings of the meeting for the use of the Institute, would agree to furnish a detailed report for such of the daily papers as would publish the same; and upon the recommendation of this committee, the Institute appropriated and placed at its disposal, a sum " not exceeding $450 for the purpose of reporting the proceedings of the Polytechnic Association."

The committee have appointed Mr. Parkhurst, as a man fully competent to fill the position required; and he has diligently attended to the trust imposed upon him, giving continued satisfaction to all.

The Polytechnic Association has continued to increase in interest, usefulness and importance, and its meetings are much more numerously attended than heretofore. It is becoming more and more an absolute necessity to the public, who, appreciating the usefulness of such an institution, are quick to take advantage of it; and we predict that the time is not far distant when it will be necessary to seek a better and more commodious room in which to hold its meetings.

CHARLES E. EMERY.
GEORGE H. BABCOCK.
ROBERT WEIR,

New York, *February 2d*, 1871.

REPORT OF THE BOARD OF MANAGERS.

The Board of Managers of the 39th annual exhibition of the American Institute, respectfully submit the following report:

At their first meeting held February 21st, 1870, the Board was formally organized by the election of Hon. Orestes Cleveland as chairman, Mr. Wm. H. Butler, vice-chairman, and the appointment of Mr. John W. Chambers as secretary.

The securing of the Empire Rink by our predecessors, under authority granted by the Institute for this exhibition not only reduced the labors of the Managers, but materially facilitated the early apportionment of space for the several departments, perfecting proper grouping and classification of the various articles exhibited, and early notification to the many exhibitors.

The amount of rent paid to Empire Rink corporation; also to owners of adjoining property and insurance upon buildings where risk had been increased, was $8,189.56.

The buildings for working machinery, together with the many and seemingly endless alterations and repairs cost $5,571.98. When completed the space covered was three acres, which, considerable as it appears, was not enough by one-third to properly display the articles within the buildings and give the proper width to the aisles. At least double the space at our disposal could have been well filled.

The question of properly lighting premises so large, was one of the most serious of the many which engaged our attention; to light well and economically being the problem. Inasmuch as it was not known where the next exhibition would be held, any large outlay for reflectors or other apparatus known to be efficient as well as economical, did not appear warranted; consequently, a large proportion of the gas paid for was not as properly and fully utilized as it might have been under conditions more favorable. The amount expended being $6,251.67.

In our efforts to make the exhibition popular and as much a place of resort as possible, we expended liberally for music and freely advertised promenade concerts, which proved not only satisfactory to our visitors, but aided largely to increase our receipts; the cost of the same $3,416, is believed to have been judicious. So well satisfied are we upon this point that we do not hesitate to recommend to our successors even greater liberality in this direction.

In consequence of the early notices issued to the inventors and producers of our country, applications for space were made as early as the 12th May, and increased to the day advertised for the reception of goods, when it was found that more space had been applied for than was at the disposal of the Managers; but by reducing the same and placing with compactness, all were finally received.

The total number of entries made and accepted were 1,678, and were for the departments as follows:

I.	Department of Fine Arts and Education	145
II.	Department of the Dwelling	380
III.	Department of Dress and Handicraft	145
IV.	Department of Chemistry and Mineralogy	189
V.	Department of Engines and Machinery	305
VI.	Department of Intercommunication	245
VII.	Department of Agriculture and Horticulture	269
	Total	1,678

Under many of these entries a large number of articles were exhibited of the same class, but of different character, increasing to a great extent the variety and general attractiveness of the exhibition.

At noon, September 7th, the exhibition was formally opened by the Hon. Orestes Cleveland, in behalf of the Managers, and able and eloquent addresses were delivered by Hon. Horace Greeley, President of the Institute, and by Dr. George B. Loring, of Salem, Mass. During the exhibition John L. Hayes, Esq., of Boston, Mass., read an able and instructive paper on the solidarity of the industries, as illustrated by the relations of the Woolen Manufacture and by A. W. Humphreys, Esq., on Iron Manufactures, and Professor Silliman, of New Haven, Conn., reviewed the progress of American industry in an earnest and interesting manner.

The President of the Institute delivered the closing address, contending that the day is not far distant, when, under favoring conditions, we would manufacture nearly everything in our catalogue of wants.

One hundred and forty gentlemen, considered competent to act as judges upon the merits of competing articles, were appointed by the Managers, upon whose reports, often requiring long and tedious labor, and to whom the Managers desire to return their thanks, the following premiums were issued:

First medals and diplomas	246
Second medals and diplomas	58
Certificates of honorable mention	550
Total	854

Several exhibitors claimed the grand medal of honor, but in the opinion of the undersigned, nothing was exhibited so entirely original or important as to warrant us in granting it. Although many exhibitions were made of new, useful and ingenious inventions and products, the one which proved most attractive was the ice making apparatus of M. J. Bujac; in connection with which he had ingeniously arranged a skating pond, upon which those skilled in this beautiful pastime had full opportunity to practice their art.

Upon authority granted the Institute at its regular meeting, November 3d, the Empire Rink was leased by the managers for the 40th exhibition, to be held in the fall of 1871; and the preliminary steps have also been taken in reference to such exhibition.

The enormous amount of detail and labor which devolves upon your Managers, not only in preparing for an exhibition, but as well during its progress and after its close, and in the belief that it could be rendered better and more profitable by the employment of a person fitted to act under the direction of the Board, they applied to the Institute for authority to employ a superintendent of exhibitions at the December meeting, which was granted; since which time they have secured the services of Mr. George Francis Dawson, formerly a most energetic and active Manager, for one year, upon the terms stipulated. He is now actively employed in the interests of the Institute, and the Managers doubt not but that his skill and labors will largely benefit the exhibitions.

The receipts and expenditures of the exhibition have been as follows:

Receipts.

Total receipts at the doors, including season, mechanic, excursion and school tickets	$62,461 65
Entry fees	3,679 00
Stands, privileges, restaurant, catalogue, etc.	5,765 25
Exhibitors, gas consumed and carpenters' work	167 86
Carried forward	$72,073 76

Brought forward	$72,073 76
Third and Second avenue railroads	1,166 66
Sales of sundries, etc.	68 20
Amount to be accounted for	$73,308 62

EXPENDITURES.

Committee on Location.			
Rent of rink, lots and insurance		$8,189 56	
Committee on Carpenter's Work and Buildings.			
Buildings for machinery, ice building and covering entrance	$3,202 33		
Lumber	1,083 18		
Hardware	226 97		
Carpenters	1,059 50		
		5,571 98	
Committee on Police, Light, Music and Decorations.			
Police, firemen and watchmen	$1,177 45		
Light: Gas, gas fitting, labor	6,251 67		
Music: Bands and organ	3,416 00		
Decorations: Covering tables, etc.	463 61		
		11,308 73	
Committee on Printing and Invitations.			
Printing circulars, posters, tickets, etc.	$1,204 45		
Stationery, blank books, paper, cards, postage, etc.	413 12		
Bill posting	169 34		
Advertising	5,124 47		
		6,911 38	
Committee on Finance and Tickets.			
Ticket sellers, receivers, etc.		1,572 75	
Committee on Steam Engines and Machinery.			
Fuel	$1,807 11		
Use of boilers, shafting, steam fitting, belting, water, etc.	3,094 99		
Superintendent, consulting engineer, etc.	599 45		
Carried forward	$5,501 55	$33,554 40	$73,308 62

Brought forward	$5,501 55	$33,554 40	$73,608 62
Testing engines, boilers and pumps	325 43		
Laborers	449 50		
		6,276 48	
Clerks, Superintendents and Laborers.			
Pay rolls		5,803 34	
Committee on Signs and Banners.			
Signs, banners, etc.		698 17	
Committee on Refreshments.			
Refreshments for managers and guests	$1,340 57		
Refreshments for judges	606 58		
Ice, for coolers	21 88		
		1,969 03	
Premiums.			
Medals and cases	$537 25		
Diplomas	140 00		
Horticultural appropriation	536 00		
		1,213 25	
Miscellaneous.			
Chemical tests	$116 85		
Insurance on buildings and fixtures	297 00		
Ice machine	188 35		
Incubator	100 00		
Fire balloons	110 00		
Use of crockery and glass for horticultural exhibition	66 13		
Badges	58 75		
Railroad tickets	126 88		
Painting, kalsomining, glazing, services of boy in cloak room, bedding, traveling expenses of orator, appropriation for workman injured at the exhibition, cartage, etc., etc.	552 60		
		1,516 56	
			51,031 23
			$22,277 39
Cash paid treasurer American Institute			22,000 00
Balance on hand January 31, 1871			$277 39

To which should be added the property purchased this year, and on hand, available for future exhibitions.

Building extending from the Machine Arcade (built last year) to the Second avenue, and roofing the entrance from the Third avenue, lumber, etc.......	$2,500 00
Steam, water and gas pipes, and fixtures	1,000 00
	$3,500 00

There are still some outstanding claims against the Managers for the following:

Steam and gas fitting..............................	$190 54
Services of engineer, test of steam engines and boilers,	125 00
Emptying sinks at the rink.........................	60 00
Advertising	17 50
Premiums: New certificate of honorable mention, engraving medals, filling diplomas and certificates not yet completed..............................	580 00
	$973 04

There was also received during the exhibition from 416 candidates for membership	$2,420 00
Arrears of fees and dues from members	1,314 00
	$3,734 00

A large portion of which would not have been received if the Institute did not hold an exhibition.

The buildings and property of the Institute at the rink has been insured in four companies until December, 1871.

On buildings....................................	$5,100 00
On fixtures	3,000 00
	$8,100 00

In closing our report, we cannot forego the pleasure of congratulating the members upon the unprecedented success of the exhibition of 1870; not alone as to its profits in dollars and cents, but also in its freedom from any unfortunate or serious accident, or loss to person or to property. We believe that the coming exhibition will surpass this as much as this has surpassed the one which has preceded it.

The immense expense which is involved in holding our exhibitions upon property not our own, is well exhibited by a reference to its items given in the first portion of this report. We think we do not over estimate, when we state that a few of the items of saving would be about as follows:

Annual loss in temporary buildings and alterations ...	$5,000 00
Annual loss in temporary gas fittings, alterations, and excessive consumption of gas, the result of imperfect arrangements	3,000 00
Annual loss in temporary shafting, putting up of same, water and steam pipes altered and changed	2,500 00
Making in these alone an annual loss of fully....	$10,500 00

Throwing out of the calculation the numberless expensive changes and repairs constantly making, all of which are lost upon the closing of the exhibition.

Could we secure a permanent location, place therein an engine with boilers of our own, start promptly upon the opening day, we would make a saving of at least $12,000 per annum, better satisfy the public, and have the satisfaction of knowing that every dollar expended in improvement would add to our future benefit, and serve as well our present wants.

The accounts and vouchers have been examined by the Finance Committee of the Institute, in accordance with the requirements of the by-laws, and have been certified by them as correct.

All of which is respectfully submitted.

ORESTES CLEVELAND.
WILLIAM H. BUTLER.
J. GROSHON HERRIOT.
CHAS. WAGER HULL.
WILLIAM S. CARPENTER.
GEORGE TIMPSON.
J. WILSON STRATTON.
JAMES KNIGHT.
THOMAS HICKS.
THOMAS RUTTER.
SAMUEL R. WELLS.
WILLIAM E. PEARSE.
JOSEPH B. LYMAN.
J. TRUMBULL SMITH.
WALTER SHRIVER.
THOS. D. STETSON.
JAMES R. SMITH.
CHARLES E. BURD.
E. S. DICKINSON.
CHAS. H. CLAYTON.
HENRY J. NEWTON.
ALEX. M. EAGLESON.
FRANK EVERDELL.
THOMAS VARKER.
A. W. HUMPHREYS.

NEW YORK, *January* 31*st*, 1871.

PREMIUMS

AWARDED AT THE THIRTY-NINTH ANNUAL EXHIBITION, 1870.*

I.—DEPARTMENT OF FINE ARTS AND EDUCATION.

FIRST GROUP.—Paintings on canvas, glass and other surfaces; pastels, cartoons, miniatures.

SECOND GROUP.—Engravings, lithographs, chromo-lithographs, chemical etchings, plain and colored, enamel work, designs and drawings relating to architecture, landscape gardening, mechanical and civil engineering.

THIRD GROUP.—Photographs, plain and colored, daguerreotypes, ambrotypes; all other impressions by the action of light.

FOURTH GROUP.—Sculpture, cameos, intaglios, medals, medallions, reliefs, embossed work, fine castings in bronze, zinc and other metals.

FIFTH GROUP.—Musical instruments—pianos, harps, organs, melodeons, portable instruments used in bands and concerts.

SIXTH GROUP.—Specimens of printing and bookbinding, books, stationery, ornamental penmanship, globes, maps, charts, and all apparatus for instructing in science; tables and machines for calculation.

SEVENTH GROUP.—Philosophical instruments, mathematical and measuring instruments, dials, chronometers, watches and clocks, telescopes, microscopes, lenses, cameras and other optical instruments, including stereoscopes, spectacles and opera glasses.

DEPARTMENT I.—GROUPS 1, 2, 3 AND 4.

Judges—Messrs. ROBERT M. PRATT, D. HUNTINGTON, OSCAR G. MASON.

L. Prang & Co., Washington street, corner Gardner street, Boston, Mass., for the best chromos. First premium.

H. Wood, Jr., 639 Broadway, New York, for chromos. Second premium.

Ferdinand Mayer & Sons, 76 and 78 Fulton street, New York, for the best lithographic prints. First premium.

William Kurtz, 872 Broadway, New York, for the best crayon drawings. First premium.

Louis Oram, 52 John street, New York, for a crayon drawing copied from a small photograph. Second premium.

A. H. Raynal, 44 Cortlandt street, New York, for the best mechanical drawing. First premium.

George H. Babcock, 44 Cortlandt street, New York, for a mechanical drawing. Second premium.

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* The kind of premium awarded does not indicate in all cases the comparative merit of the article, it being evident that the best steam engine should have a higher grade of premium than the best shoe blacking. When, therefore, a medal has not been awarded for any article of the same kind or class, the article in such class receiving "Honorable mention" is virtually the first in point of merit.

Wm. E. Moutoux, 274 Bowery, New York, for designs in hair. Honorable mention.

Edward Sears, 48 Beekman street, New York, for the best wood engravings. First premium.

Pettit & Field, 102 Nassau street, New York, for wood engravings. Second premium.

Stietz & Dreier, 76 William street, New York, for glass letters and chemical etchings on glass in connection with gold and silver. First premium.

A. McKinley, Second avenue and Seventy-seventh street, New York, for a checker-board painted on glass. Second premium.

Thomas G. Hojer, 936 Third avenue, New York, for sign painting on glass. Honorable mention.

Mrs. Charles S. Glover, 450 East Eighty-fourth street, New York, for a worsted carriage afghan. Honorable mention.

Wm. Kurtz, 872 Broadway, New York, for the best plain photograph; for the best photograph finished in India ink; for the best photograph on porcelain. First premium.

J Gurney & Son, corner of Sixteenth street and Fifth avenue, New York, for the best photographs finished in oil. First premium. For plain photographs; for photographs finished in India ink; for photographs finished in pastel. Second premium. For photographs finished in crayon. Honorable mention.

Henry Merz, 183 Essex street, New York, for plain photographs. Honorable mention.

Samuel A. Thomas, 717 Sixth avenue, New York, for photographs on porcelain. Second premium. For plain photographs. Honorable mention.

W. R. Howell, 867 Broadway, New York, for the best photographs finished in crayon. First premium. For photographs finished in India ink. Honorable mention.

Rockwood & Co., 845 Broadway, New York, for the best photographs finished in pastel; for the best large photographic views. First premium. For photographs finished in crayon; for photographs finished in oil; for a medallion portrait. Second premium.

John O'Neil, 949 Broadway, New York, for photographs. Honorable mention.

Richard Horton, 2287 Third avenue, New York, for out-door photographs. Second premium.

John Loeffler, 932 Broadway, New York, for photographs. Honorable mention.

George W. Stetson, 49 Barclay street, for the best pastel paintings. First premium.

Cornelius A. Demarest, 445 East One Hundred and Nineteenth street, New York, for the best profile portraits. First premium.

E. Meriman, 361 West Thirty-fourth street, New York, for a medallion portrait. Honorable mention.

Charles Bierstadt, Niagara Falls, New York, for stereoscopic views. First premium.

P. F. Weil, 643 Broadway, New York, for stereoscopic views. Honorable mention.

E. & H. T. Anthony, 591 Broadway, New York, for photographic requisites. First premium; for stereoscopic views. Second premiun.

Scovill Manufacturing Company, 4 Beekman street, New York, for the best photographic apparatus. First premium.

DEPARTMENT I.—GROUP 5.

Judges—Messrs. F. H. NASH, A. D. W. BESEMANN, JAMES W. PIRSSON.

F. C. Lighte & Co., 421 Broome street, New York, for the best piano forte. First premium.

Lindeman & Sons, 92 Bleecker street, New York, for the "Cycloid" piano. Second premium.

Taylor & Dupuy, 159 Bleecker street, New York, for pianos. Honorable mention.

George Jardine & Son, 314 East Thirty-ninth street, New York, for the best orchestral organ. First premium.

William Robjohn, 865 Eighth avenue, New York, for a pneumatic composition movement for the organ. Honorable mention.

George Gemunder, 205 East Ninth street, New York, for musical instruments. First premium.

John W. Tanner, 229 Third avenue, New York, for patent combination fifes. Honorable mention.

M. J. Paillard & Co., 680 Broadway, New York, for Shreiber's patent instruments. Honorable mention.

DEPARTMENT I.—GROUP 6—(*Division I*).

Judges—Messrs. BRADLEY R. HARD, JOEL W. STEARNS, J. E. TUCKER.

Charles Cory & Son, 278 Division street, New York, for the best safety check punch. First premium.

Francis & Loutrel, 45 Maiden Lane, New York, for safety tints for checks. Honorable mention.

Byron Weston, Dalton, Mass., for the best linen ledger paper. First premium.

Francis & Loutrel, 45 Maiden lane, New York, for blank books. Honorable mention.

Philip F. Van Everen, 151 Fulton street, corner Church, for adjustable book covers. Honorable mention.

B. L. Goulding, 218 Broadway, New York, for self-supplying penholders. Honorable mention.

Eberhard Faber, 133 William street, New York, for lead pencils, cedar rulers, board clips, brush handles, rubber and rings, stationers rubber, etc. Honorable mention.

D. Webster Clegg, 111 and 113 William street, New York, for patent concave combination ruler and paper cutter. Honorable mention.

Judges at Large—Messrs. JOHN MATHEWS, O. M. TINKHAM, CHARLES F. MUDGE.

George B. Fowler, 72 Ryerson street, Brooklyn, N. Y., for Fowler's adding machines. Honorable mention.

Charles H. Webb, 713 Broadway, for adding machines. Honorable mention.

GROUP 6.—(*Division II*).

Judges—Messrs. LOUIS STEPHAN, HENRY KOCH.

Hermance Tremper, 12 John street, New York, for engravings of monograms and stamping. Honorable mention.

John F. Trow, 52 Greene street, for specimens of type and printing. Honorable mention.

H. G. Eastman, Poughkeepsie, N. Y., for penman's assistant, system of penmanship and steel pens. Honorable mention.

John D. Williams, 458 West Eighteenth street, New York, for a system of ornamental and business penmanship. Honorable mention.

J. B. Moore, Morrisania, N. Y., for maps for school children. Honorable mention.

DEPARTMENT I.—GROUP 7—(*Division I*).

Judges—Messrs. JOHN COTTIAR, J. ADOLPH HAMANN, P. J. RICHRATH.

United States Watch Co., 13 Maiden Lane, for the best American watches. First premium.

New York Watch Co., Springfield, Mass., for watch movements. Honorable mention.

W. H. Horton, Jersey City, N. J., for adjustable compensating regulator. Honorable mention.

James Rodgers, 45 Liberty street, New York, for a regulator. Honorable mention.

J. Cohen, 942 Third avenue, New York, for a clock. Honorable mention.

GROUP 7—(*Division II*).

Judges—Messrs. EDWARD N. DICKERSON, JOHN J. HIGGINS, OSCAR G. MASON.

William H. Walmsley, 924 Chestnut street, Philadelphia; James W. Queen & Co., agents, 5 Dey street, New York; for the best microscopic preparations. First premium.

Thomas H. McAllister, 49 Nassau street, New York, for the best microscopes and lenses. First premium.

Thomas H. McAllister, 49 Nassau street, New York, for the best oxy-hydron and oxy-calcium stereopticons. First premium.

Otto Lohr, 133 Mercer street, New York, for a stereoscopic camera box. Honorable mention.

GROUP 7—(*Division III*).

Judges—Messrs. GEO. H. BABCOCK, HENRY M. PARKHURST, JAMES PRENTICE.

Curt W. Meyer, 86 Nassau street, New York, for electric friction machines. Honorable mention.

Charles B. Boyle, 839 Broadway, New York, for a model of the moon. Honorable mention.

Henry Whitall, 17 Park place, New York, for movable planispheres. Honorable mention.

Ed. Holland, 262 Main street, Hartford, Conn., for the improved Campbell tellurian. Honorable mention.

Marshall Long, 226 East Seventy-ninth street, New York, for a tellurian. Honorable mention.

Henry Whitall, 17 Park place, New York, for a lunatellus. Honorable mention.

Blunt & Co., 179 Water street, New York, for the best surveyor's instruments. First premium.

W. T. & T. V. Gendar, 87 Fulton street, New York, for the best hydrometers, sacchrometers and thermometers. First premium.

William H. Paine, Greenpoint, L. I., for steel measuring tapes. Honorable mention.

H. Guth, 299 Bowery, New York, for the best physical glass instruments. First premium.

R. H. Norris & Co., Paterson, N. J., for machines used in silk manufacture. Honorable mention.

Otto Lohr, 133 Mercer street, New York, for photographic dark tent. Honorable mention.

Scovill Manufacturing Co., 4 Beekman street, for the best potographic materials. First premium.

Ernst Kruger, 183 Essex street, for a photographic headrest. Honorable mention.

Curt W. Meyer, 86 Nassau street, for the best electro-magnetic instruments. First premium.

Jerome Kidder, 544 Broadway, for an electro medical apparatus. Honorable mention.

Curt W. Meyer, 86 Nassau street, for batteries. Honorable mention.

II.—DEPARTMENT OF THE DWELLING.

FIRST GROUP.—Apparatus for warming, cooling and ventilating rooms; cooking stoves, ranges and refrigerators, water filters and coolers. Apparatus for illumination, ornamental lamps, chandeliers, and gas fixtures.

SECOND GROUP.—Kitchen ware and utensils; machines and implements for washing, wringing and drying clothes; mangles, ironing and fluting machines, etc.

THIRD GROUP.—Carpets, oil cloths, matting, paper hangings and tapestry, window curtains, shades and screens. Encaustic tiles, and specimens of ornanmental flooring, fresco work, and ornamental plasterings.

FOURTH GROUP.—Furniture; mirrors, upholstery, beds, bed springs, mattresses, and room conveniences. Secretaries and ornamental safes. Ladies toilet and work boxes.

FIFTH GROUP.—Table furniture—cutlery, castors, glass, china, porcelain, silver and other ware used for holding food and condiments.

SIXTH GROUP.—Ornaments for the dwelling-house, excepting those embraced in the first department. Wax flowers and fruit, ornamental hair work and worsted embroidery, and crochet work. Passe partout, picture frames and mouldings, brackets, etc. Billiard tables, chessmen, draught and backgammon boards and tables; all other contrivances for in-door recreation and amusement.

SEVENTH GROUP.—Building accessories and permanent attachments; doors, window sash, blinds, mantels, grates, stairs, timber frames, cut and cast ornaments for the outside of dwellings. Hand pumps, plumbers' work, water closet apparatus and baths; bells, door springs, latches, bolts, sash fastenings and weights, hinges, screws, nails, and other household hardware. Useful and ornamental articles for the grounds surrounding the dwelling.

DEPARTMENT II.—GROUP 1.

Judges—Messrs. GEORGE F. MERKLEE, ROYAL E. DEANE, CHAS. H. GUINAND.

George Starrett, 229 Water street, New York, for a Sunbeam parlor stove; for a Ruby parlor stove; for a Twilight parlor stove. Honorable mention.

D. H. Lowe & Co., 708 Broadway, for a vapor stove. Honorable mention.

A. F. Kibbe, 256 Water street, for fireplace heaters and cook stoves. Second premium.

J. W. Lane & Co., 238 Water street, for the best range and furnace, and heater. First premium.

Hull, Grippen & Co., 310 Third avenue, for a heating and cooking range. Second premium.

Barry & Lane, 985 Third avenue, for the best cooking range. First premium.

George Starrett, 229 Water street, for the best portable range. First premium.

Samuel J. Hopkins, 484 Broadway, for a combined range and furnace. Honorable mention.

Geo. A. Banta, 1304 Broadway, for the best refrigerator. First premium.

Cooper & Weed, 223 East Twenty-third street, for an improved refrigerator. Second premium.

John P. Gruber, 182 Chatham street, for a perpetual cooler. Honorable mention.

Windecker & Osterweis, 137 avenue C, New York, for a water-cooler. Honorable mention.

Thomas Barrows, 209 Hall street, Brooklyn, N. Y., for a water filter. Honorable mention.

Thomas Simmons, 33 Fulton street, Brooklyn, for a Syphon filter. Honorable mention.

Thomas Simmons, 33 Fulton street, Brooklyn, for the best hydrant filter. First premium.

Van Note & Son, 434 Canal street, for a frame fender and summer piece for grates. Honorable mention.

Lucius Crandall, 5 Chatham Square, for a Shavings burner. Honorable mention.

Hamilton & Bro., Jacksonville, Ill., for an ice cream freezer. Honorable mention.

DIVISION II.

Judges—Messrs. THOMAS CARTER, OLIVER BARRETT, C. H. COVELL.

J. G. Knapp & Co., 23 Dey street, for the best study lamps. First premium.

Downer Kerosene Oil Co., 113 Maiden Lane, New York. For the best lamps. First premium.

Hawkins & Tunison, 17 Cortlandt street, for safety lamps. Honorable mention.

Joseph W. Bartlett, 569 Broadway, for street lamps. Honorable mention.

Joseph W. Bartlett, 569 Broadway, for torch and key for lighting and extinguishing street lamps. Honorable mention.

Schmidlin & Driscoll, 119 Mercer street, for the best lanterns and reflectors. First premium.

George H. Kitchen, 591 Broadway, for an improved sun-light gas fixture. Second premium.

Francis P. Doyle, 237 Center street, for lanterns. Second premium.

Kramer & Berger, 180 Grand street, for iron lanterns. Honorable mention.

J. R. Denman, 71 and 73 Barbara street, Newark, N. J., for bent glass. Honorable mention.

DEPARTMENT II.—GROUP 2—(*Division I*).

Judges—Messrs. WM. R. CORT, JAMES Y. WATKINS, JR., RICHARD E. PETERSON.

The Eccentric Laundry Manufacturing Company, 4 Dey street, New York, for a power mangle. Honorable mention.

Edward Carter, 249 River street, Troy, New York, for an elevating clothes dryer. Honorable mention.

Michael Gerhard, 201 Market street, Newark, N. J., for a vegetable cutter. Honorable mention.

D. A. Newton, 20 Cortlandt street, for a meat and vetetable cutter. Honorable mention.

Mrs. Sarah E. Saul, 204 and 210 Raymond street, Brooklyn, N. Y., for odorless kettles. Honorable mention.

David Graves, 35 Cortlandt street, for a clothes washer. Honorable mention.

The Eccentric Laundry Manufacturing Company, 4 Dey street, for a power washing machine. Honorable mention.

The King Washing Machine Company, 441 Broadway, for the royal wringer. Honorable mention.

H. C. Alexander, 54 Pine street, for a can opener. Honorable mention.

R. H. Taber, 195 Fulton street, New York, for the Monitor coffee pot. Honorable mention.

Mason Manufacturing Company, New Brunswick, N. J., for fruit jars. Second premium.

The Valve Jar Company, Philadelphia, Pa., J. W. Williams, General Agent, 250 Cumberland street, Brooklyn, N. Y., for valve jars for preserving fruits. Honorable mention.

Paul Sipos, 1,406 Pennsylvania avenue, Washington, D. C., for an improved kitchen table. Honorable mention.

John L. Young, 196 Front street, New York, for a potato masher and beefsteak pounder. Honorable mention.

E. Moneuse & Duparquet, 28 and 30 Greene street, for coffee urns and copper cooking utensils. Honorable mention.

J. S. Williams & Co., 35 Hicks street, Brooklyn, N. Y., for a steak-broiler. Honorable mention.

A. D. Chase, 197 Broadway, for a steam fruit-preserver. Honorable mention.

Berrian & Emmons, 14 Charlton street, for a mop and brush-holder. Honorable mention.

M. W. Robinson, 79 Chambers street, for an egg-beater. Honorable mention.

C. A. Clegg & Co., 20 Cortlandt street, New York, for elastic brooms. Honorable mention.

Adolph Fischer, 325 East Thirty-ninth street, New York, for a tumbler-cleaner. Honorable mention.

James & Britton, 183 Fourth street, Williamsburgh, L. I., for can tops and kettle handles. Honorable mention.

American Papier Mache Co., 29 Barclay street, New York, for papier mache goods. Honorable mention.

Heath & Smith Manufacturing Co., 44 Murray street, New York, for japanned ware. Honorable mention.

Judges at large—Messrs. JOHN MATTHEWS, O. M. TINKHAM, CHARLES F. MUDGE.

The King Washing Machine Co., 441 Broadway, New York, for the King washer. Honorable mention.

GROUP 2—(*Division II*).

Judges—Messrs. JOHN MATTHEWS, THOMAS J. SLOAN, HENRY W. STEELE.

Miss Mary P. Carpenter, San Francisco, Cal., for self-heating fluting machines. First premium.

Mrs. Henrietta H. Cole, 441 East Twenty-third street, New York, for fluting machines. Honorable mention.

Henry B. Adams, 43 Center street, New York, for the "Climax" fluting machines. Honorable mention.

C. Dion, 585 Broadway, New York, for a fluting iron. Honorable mention.

DEPARTMENT 2—GROUP 3—(*Division I*).

Judges—Messrs. JAMES H. MERCHANT, W. H. OLIVER, Z. PARISH WHEELER.

Frederick Beck & Co., 260 West Twenty-ninth street, New York, for the best paper hangings. First premium.

New York Natural Wood Printing Co., corner Fulton and Greenwich streets, New York, for the best specimens of paper hangings, impressions from wood. First premium.

Nauman Warshauer, 162 West Twenty-seventh street, New York, for wall decoration. Honorable mention.

GROUP 3—(*Division II*).

Judges—Messrs. E. A. PETERSON, L. L. FROST, JOHN R. RUSSELL.

Franklin Root, 156 Main street, Hartford, Conn.; Charles Eaton & Co., agents, 98 Liberty street, New York; for a reversible curtain fixture. Honorable mention.

Stewart Hartshorn, 62 Center street, New York, for shade rollers. Honorable mention.

Wellington Campbell, Millburn, N. Y., for composite window shade. Honorable mention.

H. B. Wiggin & Son, 29 Barclay street, New York, for window shades. Honorable mention.

Atlantic Manufacturing Co., 82 and 84 Worth street, New York, for the best seamless woven druggets. First premium.

McKune & Scott, 104 Duane street, New York, for sheepskins and wool mats. Honorable mention.

Baker & Waterbury, 10 Pine street, New York, for Worth's patent flooring. Honorable mention.

DEPARTMENT II.—GROUP 4.

Judges—Messrs. CHARLES KLEIN, HERMAN SUCKOW, FRANCIS HAYCK.

John Peard, 247 Bleecker street, for the best school desk and settee combined. Honorable mention.

George Platt & Son, 48 East Fourteenth street, for a side-board. Honorable mention.

American Store Stool Co., 25 Howard street, for folding and stationery pivot stools. Honorable mention.

Charles C. Schmitt, 426 Sixth avenue, for folding chairs. Honorable mention.

F. W. Richardson, 358 Pearl street, for folding reclining chairs, with bed and lounge combined. Honorable mention.

Platt C. Ingersoll, Greenpoint, L. I., for a dining chair. Honorable mention.

Jos. Bradley, 323 Pearl street, New York, for chairs. Honorable mention.

Dexter Howe, 169 Canal street, for rocking chairs. Honorable mention.

J. Becker & Co., Twenty-third street and Fifth avenue, for a rattan arm rocker. Honorable mention.

Edward Hagan, 109 Laurens street, for the best chair and lounge. First premium.

The Gardner Manufacturing Co., 110 Bowery, for the best book racks and writing-desks. First premium.

John F. C. Pickhardt, 169 Bleeker street, for a sofa bedstead with spring mattrass. Honorable mention.

Wm. H. Schwalbe, 132 Church street, depot, B. L. Solomons & Sons, 657 and 659 Broadway, for the best sofa bedstead. First premium.

Julius Fox, 171 Canal street, for a spring bed bottom. Honorable mention.

Charles L. Chadeayne, 83 Bowery, for the oriental steel spring bed bottom. Honorable mention.

Charles Rich, Poughkeepsie, N. Y., for the best spring bed. First premium.

Woven Wire Mattrass Co., Hartford, Conn., for the best wire mattrass. First premium.

Wm. H. Drew & Co., 122 Fulton street, Brooklyn, N. Y., for curled hair for upholstering. Honorable mention.

American Patent Sponge Co., 524 Broadway, for patent elastic spring bed, pillows and cushions. First premium.

J. L. Jackson & Bro., Twenty-eighth street and Second avenue, for opera chairs and settees. Honorable mention.

Mrs. A. M. Rodgers, 61 St. Felix street, Brooklyn, N. Y., for mosquito and fly nets. Honorable mention.

Samuel R. Scottron, 658 Broadway, for the best adjustable mirror. Honorable mention.

Judges at large—Messrs. JOHN MATTHEWS, O. M. TINKHAM, CHAS. F. MUDGE.

Patent Elastic Felt Co., 95 Duane street, for patent elastic felt cushions. Honorable mention.

Chas. Brada & Co., 70 to 76 Fulton street, for reclining barber chairs. Second premium.

DEPARTMENT II.—GROUP 5.

Judges—Messrs. CHAS. H. COVELL, THOMAS JONES, PEL P. PAGE.

Reed & Barton, Taunton Mass., for the best silver plated ware. First premium.

Simpson, Hall, Miller & Co., 19 John street, for silver plated ware. Second premium.

Lippiatt Silver Plate and Engraving Company, 19 John street, for machine finished on silver plated and other ware. First premium.

Hall, Elton & Co., 36 Park row, for silver plated forks, spoons, etc. Second premium.

Beardslee Nickel and Manufacturing Company, 82 Fulton street, Brooklyn, N. Y. for the best Nickel plated goods. First premium.

Luther L. Smith, 6 Howard street, for nickel plated goods. Second premium.

Quinnell & Harris, 447 Broome street, for cut and engraved glass. Honorable mention.

A. S. Taylor & Co., 63 and 65 Elizabeth street, for ornamental glass. Honorable mention.

Jas. M. Shaw & Co., 25 Duane street, for ornamental china ware. Honorable mention.

L. M. Ballard, 38 Reade street, for decanters and demijohns with combination lock attachment. Honorable mention.

Meriden Cutlery Company, 45 Beckman street, for the best table cutlery. First premium.

Wm. A. Walker, late N. Balen Walker, 28 Prince street, for mirrors, etc., silvered by a new process. First premium.

Judges at large—Messrs. JOHN MATHEWS, O. M. TINKHAM, CHAS. F. MUDGE.

Jas. M. Shaw & Co., 25 Duane street, for cut and engraved glass. Honorable mention.

DEPARTMENT II.—GROUP 6—*Division I*).

Judges—Messrs. WM. K. O'BRIEN, JOHN SPERRY, W. S. SPERRY.

Gardner Manufacturing Company, 110 Bowery, for looking-glass and picture frames and adjustable extension Cornice. Honorable mention.

Wm. J. Miller, 20 Pell street, for picture frames and mouldings. Honorable mention.

Mrs. Catharine Leaycraft, 319 East Fifty-third street, for shell ornaments. Honorable mention.

J. H. Collier, 78 Fulton street, for a shell frame. Honorable mention.

Helldorfer & Doer, 22 Pell street, for carving and scroll sawing. Honorable mention.

Wm. E. Gavit, 45 East Tenth street, for movable brackets, adjustable to book cases, store shelvings, etc. Honorable mention.

GROUP 6—(*Division II*).

Judges—Messrs. M. T. HUMPHREY, RICHARD P. MOORE.

Kavanagh & Decker, corner Canal and Center streets, for the best billiard table. First premium.

William W. Welling, 207 Center street, for compressed ivory goods. Honorable mention.

GROUP 6—(*Division III*).

Judges—Messrs. CHARLES WRIGHT KIRBY, A. L. CARILLO, GEORGE B. ROYS.

A de Etta Bloodgood, 630 Sixth avenue, for wax flowers, autumn leaves, and materials. Honorable mention.

Miss Matilda A. Tingley, Plainfield, N. J., for wax flowers. Honorable mention.

C. T. Raynolds & Co., 106 and 108 Fulton street, for wax flower materials. Honorable mention.

Henry D. Dumont, 75 Fulton street, for a portable fountain. Honorable mention.

John Judd, 5 Batavia street, corner Chambers, for an assortment of conjuring tricks and puzzles. Honorable mention.

John Judd, 5 Batavia street, corner Chambers, for specimens of turning. Honorable mention.

Louis P. Tibbals, 478 Broadway, for the excelsior swings. Honorable mention.

Thill & Wapler, 22 Warren street, for glass shades. Honorable mention.

John P. Connolly, 278 Pearl street, for the best American lava ware. First premium.

Alexander Buchman, 354 Bedford avenue, Brooklyn, N. Y., for a knife, fork and spoon cleaner and sharpener combined. Honorable mention.

Alexander Buchman, 354 Bedford avenue, Brooklyn, N. Y., for a toy repeating parlor gun. Honorable mention.

Alexander Buchman, 354 Bedford avenue, Brooklyn, N. Y., for self-setting mouse traps. Honorable mention.

George B. Fowler, 87 Fulton street, New York, for Fowler's new parlor ten pin game. Honorable mention.

George Brown, New Haven, Conn., for mechanical toys. Honorable mention.

P. C. Godfrey, 119 Nassau street, for an air target pistol. Honorable mention.

DEPARTMENT II—GROUP 7—(*Division I*).

Judges—Messrs. W. H. GEDNEY, MATHEW KANE.

William C. Brock, 936 Third avenue, for a wrought iron fire proof blind. Honorable mention.

Daniel Jackson, 830 Broadway, for Strong's patent letter box. Honorable mention.

William Joshua Keim, 256 W. Thirty-eighth street, New York, for double winding stairs. Honorable mention.

J. L. Jackson & Bro., Twenty-eighth street and Second avenue, for roof crestings. Honorable mention.

George Hayes, 75 Eighth avenue, for curved metal mouldings. Honorable mention.

George Hayes, 75 Eighth avenue, for sash and gutter bars. Honorable mention.

Hunter & Postly, 59 Duane street, New York, for building water-proof paper. Honorable mention.

Judges at Large—Messrs. JOHN MATTHEWS, O. M. TINKHAM, CHARLES F. MUDGE.

Samuel Adger Darrack, Newburgh, N. Y., for a combination fence. Honorable mention.

GROUP 7—(*Division II*).

Judges—Messrs. JOHN C. BOYLE, ADOLPH KLABER, URIAH DUNPHY.

J. J. & P. J. Butler, 1218 Third avenue, New York, for the best marble mantels. First premium.

Philip Schaad, 140 East Seventy-ninth street, New York, for a statuary marble mantel. Second premium.

John W. Smith, 326 East Twenty-fifth street, New York, for a marble mantel. Honorable mention.

James Coulman, 319 West Forty-second street, New York, for a marbleized slate mantel. Honorable mention.

George Platt & Son, 48 East Fourteenth street, New York, for a wood mantel. Honorable mention.

J. J. & P. J. Butler, 1218 Third avenue, New York, for an inlaid marble table. Honorable mention.

GROUP 7—(*Division III*).

Judges—Messrs. JOHN HARRISON, JOHN H. PENTZ, MICHAEL HARRISON.

George Hayes, 638½ Hudson street, New York, for a model of a turret sky-light or plain conservatory. Honorable mention.

George Hayes, 638½ Hudson street, New York, for a galvanized iron ventilating skylight. Honorable mention.

George Hayes, 638½ Hudson street, New York, for a curved extension light. Honorable mention.

Thomas N. Hickox & Co., 280 Pearl street, New York, for corrugated metallic shingles for roofing and siding houses. Honorable mention.

Osborn Manufacturing Co., 79 Bleecker street, New York, for bird and animal cages. Honorable mention.

Manhattan Brass and Manufacturing Co., First avenue, corner Twenty-second street, New York, for sheet and roll brass, tubing, etc. First premium.

J. L. Mott Iron Works, corner Cliff and Beekman streets, New York, for the best cast, zinc and iron figures. First premium.

GROUP 7—(*Division IV*).

Judges—Messrs. JAMES E. HALSEY, OSCAR A. NATHUSIUS.

Edwin Holmes, 7 Murray street, New York, for the best electro house annunciator; for the best electro magnetic protector for banks, safes and vaults; for the best electro magnetic hotel annunciator; for the best electro burglar alarm telegraph; for the best electro bank alarm bell; for the best electro case of burglar alarm; for telegraph bell and indicator. First premium.

American Spiral Spring Butt Co., 27 Park row, New York, for spiral spring butts. Honorable mention.

Crooke & Co., Eleventh avenue, corner Fifteenth street, New York, for butt hinges and faced iron sheets. First premium.

Albert P. Seymour, Jr., Hecla Works, Oneida county, N. Y., for right or left hand blind hinge, with improved surface fastener. Honorable mention.

Sloan Blind Lock Co., 424 East Twenty-third street, New York, for the Sloan blind lock. First premium.

Ambrose Tower, 15 Laight street, for an adjustable blind holder and fastener. Honorable mention.

C. C. Dickerman, 55 Devonshire street, Boston, Mass., for the best locks. First premium.

Whiting Lock Co., Bath, Me., for locks. Second premium.

Frank Reed, 322 West Twenty-fourth street, for a door and French window fastner, with lock combined. Honorable mention.

Ornamental Wood Co., Bridgeport, Conn., for wood door knobs. Honorable mention.

American Stair Rod Co., 310 Broadway, for stair rods. Honorable mention.

Oscar Nicholson, 208 Broadway, for a safety coat hook. Honorable mention.

Newman & Capron, 1172 Broadway, for a roller-sliding door sheave. Honorable mention.

Newman & Capron, 1172 Broadway, for a sliding door fixtures. Honorable mention.

Group 7—(*Division V*).

Judges—Messrs. Thomas Carter, Oliver Barrett, Chas. H. Covell.

Samuel Bissicks, 207 to 211 East Twenty-second street, for plumbers' materials. Honorable mention.

John McNeven, 28 St. Marks' place, for the best steam bath. First premium.

H. N. Taft, 18 Lafayette place, for a portable suspension bath. Second premium.

Henry Steeger, 143 East Thirty-first street, for a copper bath tub. Honorable mention.

Henry Steeger, 143 East Thirty-first street, for a copper shower. Honorable mention.

The Colwells', Shaw & Willard Manufacturing Co., 213 Canal street, New York, for the best tin-lined lead pipe. First premium.

Earth Closet Co., Hartford, Conn., H. P. Gray, agent, 696 Broadway, for the best earth closet commodes. First premium.

Enos Woodruff, Elizabeth, N. J , for earth closets. Second premium.

Earth Closet Co., Hartford, Conn., H. P. Gray, 696 Broadway, for an apparatus for fixed closets. Honorable mention.

Henry Steeger, 143 East Thirty-first street, for a copper sink. Honorable mention.

Henry Moore, 41 Center street, for faucets and water-closet valves. Honorable mention.

Geo. Taylor, 97 Cliff street, for a non-drip measuring cock. Honorable mention.

Nicholas Hotz, Greenpoint, L. I., for a hydrant and hose pipes. Honorable mention.

Victor E. Manger, 110 Reade street, for glass lights. Honorable mention.

III.—DEPARTMENT OF DRESS AND HANDICRAFT.

First Group.—Apparel for ladies—hats, bonnets, hair work, dresses, hose, boots and shoes, gloves, shawls, cloaks, mantillas, manufactured furs.

Second Group.—Apparel for gentlemen—hats, caps, wigs, toupees, etc., coats, vests, pantaloons, shoes, boots, gloves, overcoats, cloaks, undergarments, furs.

Third Group.—Cloths of wool, cotton and silk; all other fabrics woven, knit, or felted, excepting carpets; ribbon, cord, tassels, thread, buttons, pins, and other materials used in combination with cloth for dresses.

Fourth Group.—Hand implements used in manufacturing dress — Sewing machines, knitting machines, needles, thimbles, scissors, pocket knives, razors, etc.

Fifth Group.—Medical and surgical apparatus and instruments; trusses, artificial limbs, specimens of dentistry and dental instruments.

Sixth Group.—Jewelry and ornaments for the person; attachments used in outdoor sports—Skates, fishing tackle, hunting and shooting apparatus; gymnastic implements, and toys for children.

Meerschaum and other smoking pipes. Cases for pipes and cigars.

Seventh Group.—Portable writing desks, portfolios, pocket pens and pencils, pocket books.

Trunks, carpet bags, recticules, traveling cases, umbrellas, parasols, canes.

Hand instruments not elsewhere enumerated.

Department III.—Group 1—(*Division I*).

Judges—Messrs. Stephen Hyatt, H. B. Burtnett.

Sarah E. Saul, 204 Raymond street, Brooklyn, N. Y., for the best life preserving skirt. First premium.

Seamless Clothing Manufacturing Company, 462 Broome street, for the best seamless skirts. First premium.

S. Y. L'Hommedieu, 54 and 56 Worth street, for the "Marie Antoinette" skirts. Honorable mention.

Hegle & Davett, 579 Broadway, for refinishing and dyeing of gloves. Second premium.

William A. Rees, 392 Bowery, for cleaned and dyed kid gloves. Honorable mention.

Chaffee & Shreve, 96 Franklin street, for the best cotton hosiery. First premium.

Nunns & Seil, 349 Fourth avenue, for ladies French shoes. Honorable mention.

Neil McCallum, 19 Spruce street, for fancy shoe trimmings. Honorable mention.

United States Metallic Heel Co., 220 Front street, for metallic heels. Honorable mention.

John R. Terry, 19 Union square, for ladies' and gents hats and furs. Honorable mention.

Mrs. Ann Longrigg, 1013 Third avenue, for hand-knit and crochet goods. Honorable mention.

Madam Catharina Schiess, 140 E. Twelfth street, for linen embroidery. Honorable mention.

Hamilton E. Smith, 55 Hudson street, for multiple sponge goods. Honorable mention.

Mrs. R. Eberle, 114 E. Eleventh street, for stocking supporters. Honorable mention.

Madame Demorest, 838 Broadway, for ladies' and children's combination suspender and shoulder strap. Honorable mention.

Almy & Co., 65 and 67 Leonard street, for the best shawls. First premium.

George Betts, 581 Broadway, for twine cutters. Honorable mention.

GROUP 2—(*Division II*).

Judges—Messrs. STEPHEN HYATT, H. B. BURTNETT.

C. Benkert & Son, 705 Broadway, for fine boots and shoes. Honorable mention.

Starr Knitting Co., Cohoes, N. Y., Rhoades & Grosvenor, agents, 56 White street, for the best merino knit shirts and drawers. First premium.

Vanderlip & Taylor, 96 Bowery, for dress shirts and collars. Honorable mention.

Andrus Bros. & Adams, 55 Hudson street, for the best perforated buckskin undergarments. First premium.

James L. Libby, 78 Center street, for paper collars and cuffs. Honorable mention.

Post, Herkner & Co., 19 Murray street, for wool surface flocked rubber fabric. First premium.

Randolph Clothing Emporium, 684 Broadway, for boys' and children's clothing. Honorable mention.

National Suspender Co., 345 Broadway, for suspenders. Honorable mention.

Mark L. Winn, 13 W. Twenty-seventh street, for shampooing helmets. Honorable mention.

W. W. Simons, 78 Carmine street, for renovated gents' silk hats. Honorable mention.

DEPARTMENT III.—GROUP 3.

Judges—Messrs. JAMES H. SACKETT, CHARLES F. THOMAS.

Heminway & Sons Silk Co., agents, 78 Reade street, for the best sewing silk and twist. First premium.

R. H. Norris & Co., Paterson, N. J., for spool show cases. Honorable mention.

E. T. Dyer, 346 Broadway, for black doeskin. Honorable mention.

Tucker, Carter & Co., 70 South street, for the best gunny cloth. First premium.

Peckham Manufacturing Co., Providence, R. I., for the best woolen yarns. First premium.

F. P. Salomons, 32 Beaver street, New York, for the best woolen blankets and flannels. First premium.

Porter Bros., & Co., 443 Broadway, for patent fastening suspender buttons. First premium.

New Britain Lace Co., 110 Franklin street, for the best blonde laces. First premium.

Nottingham Lace Works, 49 Barclay street, for silk lace hair nets. Honorable mention.

William Simpson & Sons, Philadelphia, Pa. J. &. J. T. Lea & Co., agents, 191 Church street, New York, for the best fast blacks and mourning prints. First premium.

Bachman Bros., 89 Worth street, for the best silk dress goods. First premium.

John A. Spooner, 38 John street, for glove buttons. Honorable mention.

Mrs. E. Carter, 23 Union square, New York, for the best antique and modern laces. First premium.

Atlantic Delaine Co., Providence, R. I.; Hoyt, Spragues & Co., agents, 107 Franklin street, New York; for the best dress goods and Italian cloths. First premium.

A. & W. Sprague, Providence, R. I.; Hoyt, Spragues & Co., agents, 107 Franklin street, New York; for the best madder calicoes. First premium.

Mrs. S B. Hunt, 29 East Twenty-first, New York, for a knitted national flag. Honorable mention.

Cheney Brothers, Hartford, Conn.; A. T. Stewart & Co., agents, New York city; for the best silk goods. First premium.

DEPARTMENT III.—GROUP 4.

Judges—Messrs. THOMAS J. SLOAN, HENRY W. STEELE.

Bartlett Reversible Sewing Machine Co., 817 Broadway, New York, for the best single thread sewing machine. First premium.

Blees Sewing Machine Co., 623 Broadway, New York, for sewing machines. Second premium.

William H. Nichols, 572 and 574 Broadway, New York, for the best button-hole and overseaming sewing machine. First premium.

O. H. Needham, 345 Fourth avenue, New York, for the best sewing machine starter. First premium.

John J. Sibley, 636 Broadway, New York, for the best tuck creaser for sewing machines. First premium.

Jasper H. Singer, 636 Broadway, New York, for a rotating treadle for sewing machines. First premium.

Howard & Co., 436 Broadway, New York, for the best button hole attachment. First premium.

Sewing Machine Attachment Co., 544 Broadway, New York, for scissors and needle sharpener. Honorable mention.

Albert Komp, 215 Center street, New York, for the best self-feeding eye letting machine. First premium.

Dana Bickford, 572 and 574 Broadway, New York, for the best knitting machines. First premium.

Charles G. Mortimer, 33 Barclay street, New York, for the acme linen marker. Honorable mention.

Pratt, Palmer & Co., 384 Broadway, New York, for the best bobbin winder for sewing machines. First premium.

Miss Mary P. Carpenter, San Francisco, Cal., for the best self-threading needle. First premium.

Mrs. Sarah A. Sexton, 668 Sixth avenue, New York, for a sewing machine seat. Honorable mention.

DEPARTMENT III.—GROUP 5—(*Division I*).

Judges—Messrs. FRANK H. HAMILTON, M. D., HARVEY S. GAY, M. D., WM. H. VAN BUREN, M. D.

A. A. Marks, 575 Broadway, for the best artificial limbs. First premium.

W. Pomeroy & Co., 544 Broadway, for a finger pad truss. Honorable mention.

S. H. Mann, Orange, N. J., for "the reactionary lifter." Honorable mention.

Thomas McIlroy, 151 Perry street, for an invalid and fracture bedstead; for an invalid and elevating bedstead; for a surgical operating chair; for an oculist's operating chair. Honorable mention.

GROUP 5—(*Division II*).

Judges—Messrs. JOHN G. AMBLER, M. D., JAHIEL PARMLY.

Samuel S. White, Philadelphia, Pa., and 767 and 769 Broadway, New York, for the best artificial teeth and dental instruments. First premium.

John Allen & Son, 22 Bond street, for artificial dentures. Honorable mention.

DEPARTMENT III.—GROUP 6.

Judges—Messrs. STEPHEN PELL, ROBERT A. JOHNSON, WILLIAM RUTTER.

Moses Kinsey, 75 Bank street, Newark, N. J., for the Young America skates. Honorable mention.

Carl Stehr, 347 Broome street, for artistic taste and workmanship on meerschaum and amber goods. First premium.

American Flask and Cap Co., 52 Beekman street, New York, for the best powder flasks, shot pouches and percussion caps. First premium.

Shannon, Miller & Crane, 46 Maiden Lane, for military, theatrical, church, society goods, costumers' materials, and all kinds of gold and silver trimmings. Honorable mention.

Harvey & Ford, 63 Lispenard street, for carved ivory and briar wood pipes. Honorable mention.

DEPARTMENT III—GROUP 7.

Judges—Messrs. JAMES L. TODD, STEPHEN HYATT.

C. Hodge Hudson, 61 Clinton place, for shielded trunks. Honorable mention.

Upright Patent Trunk Co., 6 Barclay street, for upright trunks. Honorable mention.

John W. Thorne, 53 Fulton street, for trunks. Honorable mention.

Solomon Oppenheimer, Newark, N. J., for metallic stay strap for trunks. Honorable mention.

Mrs. Julia W. D. Patten, 720 Thirteenth street, Washington, D. C., for an extension traveling bag. Honorable mention.

Ellis, Knapp & Co., 24 Walker street, New York, for umbrellas and parasols, with burglar-proof lock runners. Honorable mention.

George A. Harley, 6 City Hall Place, for a hair cutter. Honorable mention.

New York Manufacturing Company, 21 Cortlandt street, for a razor honing machine. Honorable mention.

Culbert & Co., 24 Maiden lane, New York, for pocket books. Honorable mention.

N. C. Stiles, Middletown, Conn., for toe, instep and combined stretchers. Honorable mention.

James H. Bennett, 13 Commercial street, Newark, N. J., for the American traveling trunk. Honorable mention.

IV.—DEPARTMENT OF CHEMISTRY AND MINERALOGY.

FIRST GROUP.—Soaps, and all compounds for cleansing; toilet preparations, containing no deleterious ingredient.

Candles, oils, wax, resins, hydro-carbon compounds, and other natural or artificial products used for illuminating purposes.

SECOND GROUP.—Acids, alkalies, other chemical bases; salts, artificial fertilizers.

Soda water and apparatus for making it; mineral waters; wines, beverages and stimulants; Tobacco, cigars and snuff.

Drugs, medicines, tinctures and extracts of official or known composition. Disinfectants and deodorizers; chemicals not elsewhere provided for.

THIRD GROUP.—Leather, skins, peltry, furs parchment, specimens of taxidermy, catgut goldbeaters' skin, membrane preparations; preserved wood, fiber, leaves and other natural products used in the arts.

FOURTH GROUP.—India rubber and gutta percha preparations, papier mache.

Artificial stone, brick, specimens of pottery, earthen ware, porcelain, china and glass.

Crucibles, cements, prepared materials for roofing.

FIFTH GROUP.—Paints, dye-stuffs, inks; specimens of dyed yarns, tissues, and other colored substances and specimens of bleaching.

Preparations for staining, cleaning, and polishing; varnishes, blueing, blacking.

Sixth Group.—Flour, meal, and other prepared products used as food.

Samples of baking and pastry cooking, sugars, confectionery, chocolate, cocoa; prepared condiments; preserved fruit, vegetables and meats; condensed fluids; extracts used in preparing beverages.

Seventh Group.—Specimens of natural stones used in building; minerals, ores, metals, alloys.

Models of apparatus and implements used in chemical works and the laboratory.

Apparatus for making gas; machines for expediting chemical changes.

Department IV.—Groups 1 and 2.

Judges—Messrs. Julius G. Pohlie, Charles F. Chandler, F. A. P. Barnard, Albert G. Kelley.

J. C. Hull's Son, 32 Park Row, New York, for toilet soaps. Of the first order of merit. The exhibitor being a manager of the fair is debarred from receiving a premium.

Hilliard & Adams Manufacturing Co., 168 Fulton street, New York, for toilet soaps. Second premium.

G. M. Dusenbury & Co., 203 Pearl street, for toilet soaps. Honorable mention.

The Holbrook Manufacturing Co., 34 Church street, New York, for soaps for technical uses. Honorable mention.

Enoch Morgan's Sons, 211 Washington street, for sapolio. Honorable mention.

John Matthews, 447 to 453 First avenue, New York, for the best porcelain lined soda water fountain. First premium.

William Gee, corner Elm and Franklin streets, for tin lined soda water fountains. Second premium.

John Matthews, First avenue, between Twenty-sixth and Twenty-seventh streets, for the best apparatus for cooling and dispensing mineral waters, soda water and syrups. First premium.

John Matthews, First avenue, between Twenty-sixth and Twenty-seventh streets, for the best apparatus for manufacturing pure soda water, mineral waters, etc. First premium.

William Gee, corner Elm and Franklin streets, for apparatus for manufacturing soda water. Second premium.

John Matthews, First avenue, between Twenty-sixth and Twenty-seventh streets, for bottles and stoppers. Honorable mention.

Downer Kerosene Oil Co., 108 Water street, Boston, Mass., for Downer's mineral sperm. First premium.

Charles Pratt, 108 Fulton street, New York, for Pratt's astral oil. First premium.

Downer Kerosene Oil Co., 113 Maiden Lane, New York, for Downer's standard kerosene oil. Second premium.

W. H. Schieffelin & Co., 170 William street, for medicinal extracts. First premium.

James R. Mercein, 41 Montgomery street, Jersey City, N. J., for medicinal fluid extracts. Second premium.

James B. Horner, 88 William street, for oils of peppermint, wintergreen, spearmint, sassafras and pennyroyal. First premium.

Henry S. Pilkinton, 88 William street, for oils of peppermint. Honorable mention.

Charles T. White & Co., 29 Liberty street, for the best chemicals. First premium.

Walter & Baumgarten, 197 Pearl street, for the best commercial nitric acid and hydro-chlorine acid, tin crystals and disinfecting fluid. First premium.

Newton Squire, 10 Burling slip, New York, for hydro-fluoric acid. Honorable mention.

L. & J. W. Feuchtwanger, 55 Cedar street, New York, for silicates of soda. Honorable mention.

Glamorgan Soap Co., 45 Broadway, New York, for cotton seed oil. Honorable mention.

The Great American Sanitary Co., 750 Broadway, New York; John A. Hoffman, agent, 750 Broadway, New York; for handkerchief perfumes of delicate odor, and pure. Honorable mention.

E. & H. T. Anthony & Co., 591 Broadway, New York, for the best soluble cotton for photographic purposes. First premium.

William R. Warner & Co., 544 North Eleventh street, Philadelphia, Penn., for sugar coated pills. Honorable mention.

Pleasant Valley Wine Co., Hammondsport, N. Y., for sparkling wines. Honorable mention.

E. C. Hazard, 192 and 194 Chambers street, New York, for Saratoga Geyser water. Honorable mention.

New York Match Co., 4 Park place, New York, for matches. Honorable mention.

GROUP 2—(*Division II*).

Judges—Messrs. J. M. MASTERTON, AUGUSTUS WETMORE, JR., STEVENSON TOWLE.

S. Rapp, 75 Fulton street, New York, for smoking and chewing tobacco. Honorable mention.

GROUP 2—(*Division III*).

Judges—Messrs. E. BIERSTADT, O. W. TINKHAM.

John Matthews, First avenue, between Twenty-sixth and Twenty-seventh streets, New York, for cork fasteners. Honorable mention.

John Matthews, First avenue, between Twenty-six and Twenty-seventh streets, for a patent automatic tumbler washer. Honorable mention.

John Matthews, First avenue, between Twenty-sixth and Twenty-seventh streets, New York, for an apparatus for filling and closing bottles; for an apparatus for filling syphons. First premium.

William Gee, corner Elm and Franklin streets, New York, for an apparatus for filling syphons. Second premium.

P. M. Sherwood, 85 Liberty street, New York, for an automatic bottle filler. First premium.

DEPARTMENT IV.—GROUP 3.

Judges—Messrs. WILLIAM PALEN, JOHN TUTTLE, THOMAS KECK.

The judges appointed to examine sole leather, competing for the special gold medals offered by Jackson S. Schultz, Esq., decided not to award at this exhibition.

1. For the reason that so few samples have been offered.

2. That time sufficient for the proper preparation and tanning of leather has not been had since the first public notice was given.

3. The leather offered having been prepared from such a variety of hides of different grades and qualities that judgment cannot properly be given.

The full and interesting report of the judges has been published in the Shoe and Leather Reporter, and will be published in the annual report of the Institute, to which those interested are referred.

DEPARTMENT IV.—GROUP 4.

Judges—Messrs. STEVENSON TOWLE, JOHN M. MASTERTON, A. WETMORE, JR.

Thomas Hodson, 17 Beach place, Brooklyn, N. Y., for artificial stone. Honorable mention.

Union Paste and Sizing Company, 22 Pell street, for prepared paste. Honorable mention.

Henry W. Johns, 78 William street, for the best improved roofing. First premium

DEPARTMENT IV.—GROUP 5.

Judges—Messrs. DUBOIS D. PARMELEE, ADOLPH OTT.

John C. Giffing, 44 Water street, for the best copper paint for vessels' bottoms First premium.

C. T. Raynolds & Co., 106 and 108 Fulton street, for the best paints dry and in oil. First premium.

Lehigh Metallic Paint Works, Lehigh Gap, Pa., Robert D. Sharpe, Agent, 165 Pearl street, New York, for Lehigh standard brown metallic paint. Honorable mention.

George W. Kittelle, 99 Maiden lane, New York, for the "Manhattan" liquid dryer. Honorable mention.

Valentine & Co., 88 Chambers street, for coach and railway varnishes. Honorable mention.

Salem White Lead Company, Salem, Mass., for the best white lead. First premium.

C. T. Raynolds & Co., 106 and 108 Fulton street, for the best Bartlett's substitute for white lead. First premium.

G. De Cardova, 62 William street, for dry extract of annatto. Honorable mention.

Coffin, Redington & Co., 85 Liberty street, for electro silicon. Honorable mention.

Josephus B. Trumbull, 63½ First street, for the "American Challenge" blacking. Honorable mention.

J. Monroe Taylor, 112 Liberty street, for blueing. Honorable mention.

George A. Cowles, 122 Columbia street, Brooklyn, N. Y., for the best writing fluid and copying ink. First premium.

Samuel S. Stafford, 218 Pearl street, for violet ink, writing fluid and black ink. Second premium.

Thomas D. Leak, 378 Bleecker street, for Worden & Hyatt's fancy colored inks and water colors. Honorable mention.

P. D. Reed, 262 West Fortieth street, for indestructible ink. Honorable mention.

Marx & Rawolle, 179 William street, for the best glycerine. First premium.

Charles Bond, One Hundred and twenty-sixth street, near Third avenue, for bronze black for coloring leather shoes, etc. Honorable mention.

Roth & Weber, 7 and 9 West Twenty-third street, for renovated brocatel plush, reps and leather. Honorable mention.

Albert King, Paterson, N. J., for specimens of dyeing of sewing silks, tailors' twist and organzine. Honorable mention.

The Joseph Dixon Crucible Co., Jersey City, N. J., for crucible stove polish and plumbago; of the first order of merit. The president of the company, being a manager of the fair, it is debarred from receiving a premium.

DEPARTMENT IV.—GROUP 6.

Judges—Messrs. WILLET SEAMAN, JACOB WALL.

Geo. F. Gantz & Co., 136 and 138 Cedar street, for the best baking powder, "Sea Foam," lemon sugar and cream of tartar. First premium.

E. N. Horsford, Cambridge, Mass., Wilson, Lockwood, Everett & Co., agents, 201 Fulton street, New York, for cream of tartar and bread preparation. Second premium.

Royal Baking Powder Co., 178 Duane street, for royal baking powder. Honorable mention.

Carter, Mann & Co., Boston, Mass., for the best yeast cakes, "Boston Concentrated." First premium.

James Morton, 128 Fulton avenue, Brooklyn, N. Y., for biscuits. Honorable mention.

Jewell Bros., 2, 4 and 6 Fulton street, Brooklyn, N. Y., for the best self-leavening flour. First premium.

Hecker & Bro., 201 Cherry street, for self-raising flour. Second premium.

Hecker & Bro., 201 Cherry street, for the best flour, "superlative plain," farina and wheaten grits. First premium.

The Rand Sea Moss Farine Co., 53 Park place, for the best farine, "sea moss." First premium.

Isaac Rich & Co., Boston, Mass., for spiced salmon. Honorable mention.

Portland Packing Co., Portland, Me., for the best fish, meats and vegetables, hermetically sealed. First premium.

Azel S. Lyman, 212 Second avenue, for roast beef, "Lyman's Concentrated." Honorable mention.

J. G. Gabaudan, 925 Broadway, for flavoring extracts. Honorable mention.

Edmund S. Baker, 52 Cannon street, for the best hams, bacon and beef tongues; "Young American." First premium.

Charles E. Bostwick, 16 Atlantic street, Brooklyn, N. Y., for American Worcestershire sauce. Honorable mention.

E. C. Hazard, 192 and 194 Chambers street, for Cassava, "Hazard's Brazillian," and chocolate jelly. Honorable mention.

R. H. Taber, 195 Fulton street, for food, "Comstock Rational." Honorable mention.

Carle & Strong, 153 Water street, for granum, "Imperial." Honorable mention.

Schall & Co., 388 Pearl street, for a confectionery ornament. Honorable mention.

John Kornarens, 630 Third avenue, for confectionery. Honorable mention.

Davis, McKean & Co., Philadelphia, Pa., for loaf and granulated sugar. Honorable mention.

DEPARTMENT IV.—GROUP 7.

Judges—Messrs. JULIUS G. POHLE, CHARLES F. CHANDLER, F. A. P. BARNARD, ALBERT G. KELLEY.

John Matthews, First avenue, between Twenty-sixth and Twenty-seventh streets, for the best champagne apparatus. First premium.

George Miller Sternberg, 19 Platt street, New York, for the best electro-magnetic regulator for dampers and valves. First premium.

The Woodward Gas Carbonizing Co. of New York, 163 Broadway, for the best gas carbonizer. First premium.

New York Gas Saving Meter Co., 2 Dey street, for Covel's gas carburetter. Second premium.

Matthew J. Bujac, 17 Broad street, for the best ice making machine. First premium.

Robert C. Morton, Jersey City, N. J., for the best ore separator and concentrator. First premium.

Elijah Brady, 39 Greene street, for a triturator. Honorable mention.

Charles A. Seeley, 26 Pine street, for creosoted wood and machinery for creosoting. Honorable mention.

School of Mines Columbia College, East Forty-ninth street, near Fourth avenue, for mineral specimens. Honorable mention.

Mad'selle A. G. de Blossieres 50 West Fifteenth street, for sea mosses. Honorable mention.

V.—DEPARTMENT OF ENGINES AND MACHINERY.

First Group.—Stationary engines driven by steam, heated air and other gases; water engines and water wheels, and all other prime movers; boilers, steam-superheaters, safety valves, steam indicators and governors, dynamometers; steam gauges, and other safety apparatus for boilers, or to be attached to engines.

Second Group.—Pumping machinery, steam fire engines in operation, and other engines and apparatus for moving fluids; air pumps, fan blowers, etc.; pipes for conveying water and other fluids; valves, cocks, joints, and other appliances used in connection therewith.

Third Group.—Machinery for working metals, lathes, planers, screw-cutting machinery, drills, shaping and slotting machines, emery wheels, and all tools and apparatus used in working metals.

Fourth Group.—Machinery for working in wood; lathes, saws, planing machines, boring machines, machines for mortising and tenoning; carpenters' tools, and other tools and apparatus for working in wood.

Fifth Group.—Machinery for preparing fibers and tissues; carders, pickers, etc.; machinery and all appliances used in the manufacture of cloth, carpeting, etc.; spinning frames, spoolers, looms; machinery used in printing.

Sixth Group.—Machinery and tools used in the manufacture of leather, India rubber, papier mache, paper, porcelain, pottery, bricks, and materials used in the arts not elsewhere specified.

Seventh Group.—Machinery for grinding or crushing grain, paint, plumbago and other natural products; gearing, millwork, friction pullies, and elements of machinery for varying speed or power; all tools used by artisans or in factories, not otherwise provided for.

Department V.—Group 1.

Judges—Messrs. F. A. P. Barnard, Thomas J. Sloan, Robert Weir.

Allen Engine Works, Fourth avenue and One Hundred and Thirtieth street, for the best steam engine. First premium.

Handren & Ripley, corner Albany and Washington streets, for a vertical engine. Second premium.

Greene, Trowbridge and Baldwin, 326 and 328 Delancey street, for an upright balance engine. Honorable mention.

New York Safety Steam Power Co., 44 Cortlandt street, for a vertical engine. Honorable mention.

Russell & Speer, 25 Lawrence street, Newark, N. J., for Baxter's portable steam engines. First premium.

C. Edward Copeland, 42 Cortlandt street, for a portable steam engine. Honorable mention.

James A. Robinson, 130 Broadway, for an Ericsson caloric pumping engine. Honorable mention.

David G. Starkey, 337 East Eighty-third street, for a reciprocating engine. Honorable mention.

Edward P. Hampson, 38 Cortlandt street, for an agricultural engine. Honorable mention.

Cornelius H. DeLamater, foot of West Thirteenth street, for Bacon's steam hoisting engines. Honorable mention.

William H. Place, 8 Attorney street, for marine governors and valves. First premium.

Chase & Hewes, 93 Liberty street, for Huntoon's governor. First premium.

Greene, Trowbridge & Baldwin, 326 and 328 Delancey street, for a check valve. Honorable mention.

Charles G. Willing, 88 John street, for the best steam gauges. First premium.

The Recording Steam Gauge Co., 91 Liberty street, for a recording steam gauge. First premium.

August Schmidt & Bro., 41 Center street, for steam gauges. Honorable mention.

D. P. Davis, 44 Cortlandt street, for a recording pressure gauge. Honorable mention.

Robert Berryman, Hartford, Conn., for a feed water regulator. First premium.

Hugh Pringle, 172 Seventh street, New York, for the best lubricator. First premium.

Greene, Trowbridge & Baldwin, 326 and 328 Delancy street, for the union lubricator. Honorable mention.

Mrs. E. D. Murfey, 32 West Twenty-ninth street, for an anti-lubricating step, bolster, and journal packing for running without oil or grease. First premium.

Union Water Meter Co., Worcester, Mass., for Fitt's steam pressure regulator. First premium.

Union Vise Co., Boston, Mass., for Ross' steam permeators. Honorable mention.

John W. Sutton, 528 Water street, for a rotation dynamometer. First premium.

William H. McNary, 59 Jefferson street, Brooklyn, N. Y., for a counting register. First premium.

Garrett S. Nevins, Bushnell, Ill., for a speed indicator. Honorable mention.

Allen Engine Works, Fourth avenue and One Hundred and Thirtieth street, for the "Allen Boiler." First premium.

Densmore & Co., 616 West Forty-third street, for Densmore sectional tubular boiler. Second premium.

William D. Andrews & Bro., 414 Water street, for a superheating steam boiler. Honorable mention.

Allen Engine Works, Fourth avenue and One Hundred and Thirtieth street, for standards of surface, iron straight edges, surface plates and angle plates. First premium.

Allen Engine Works, Fourth avenue and One Hundred and Thirtieth street, for a set of standard hobs for cutting screw threads according to the American system. First premium.

Snyder Manufacturing Co., 135 Greenwich street, for Snyder's boiler jackets. First premium.

United States and Foreign Salamander Felting Co., Troy, N. Y., for salamander felting. Second premium.

Ainsworth & Sharpe, Troy, N. Y., for the Sabbaton non-conducting boiler covering. Honorable mention.

L. B. Tupper, 120 West street, for furnace grate bars. First premium.

W. W. Tupper & Co., 206 West street, for Smith's patent furnace grates. Second premium.

Samuel S. Bent, 408 to 422 East Twenty-sixth street, for Adam's patent grate bars. Honorable mention.

Perry & Spencer, 781 Broad street, Newark, N. J., for steel tube brushes for cleaning out tubular boilers, and brush for cleaning flues of steam boilers. Honorable mention.

Copeland & Quinlan, 307 Broadway, for a patent plug, ferrule and reducer for leaky tubes in steam boilers. Honorable mention.

George Talcott, 96 Liberty street, for Reynold's turbine water wheel. First premium.

E. C. Boyles, 367 Broome street, for a model of Boyles improved water wheel. Second premium.

L. D. Parsons, Tremont, N. J., for the Union wind mill and fountain. Honorable mention.

Densmore & Co. 616 West Forty-third street, for a feed pump. Honorable mention.

Judges at large—Messrs. John Matthews, O. M. Tinkham, Chas. F. Mudge.

Downer Kerosene Oil Co., 113 Maiden lane, N. Y., for lubricating oil. First premium.

Allen N. Leet, Jr., cornor McWharter and Johnson streets, Newark, N. J., for Grogan's patent lubricating compound. Honorable mention.

Department V.—Group 2.

Judges—Messrs. Chas. E. Emery, Mason R. Pierce, Edward S. Magee.

Charles B. Hardick, 9 Adams street, Brooklyn, N. Y., for the best direct acting steam pump. First premium.

Valley Machine Co., East Hampton, Mass., for the best steam pump for feeding boilers. First premium.

Woodward Steam Pump Manufacturing Co., 76, 78 and 80 Center street, for duplex pumps. First premium.

Wm. D. Andrews & Bro., 414 Water street, for a centrifugal pump. First premium.

Wm. D. Andrews & Bro., 414 Water street, for a central discharge centrifugal pump. Second premium.

J. H. A. Gericke, 169 Broadway, for a turbinate force pump. Honorable mention.

Bridgeport Manufacturing Co., 55 Chambers street, for the American submerged pump for ships and wells on test. First premium.

The Forrester Manufacturing Co., Bridgeport, Conn., for a double acting force pump. Second premium.

Thomas Hanson, 405 East Eighty-fourth street, for a deep well and distance pump. Honorable mention.

Bernhard Vater, 767 Broadway, for a water elevator. Honorable mention.

Cowing & Co., 78 Chambers street, for a garden engine. Honorable mention.

Bridgeport Manufacturing Co., 55 Chambers street, for a fountain pump. Honorable mention.

Cowing & Co., 78 Chambers street, for a complete and attractive display of pumps and other articles, and for superior workmanship. First premium

Cowing & Co., 55 Chambers street, for a railroad force pump. Honorable mention.

Cowing & Co., 55 Chambers street, for a molasses or hot water pump. Honorable mention.

Cowing & Co., 55 Chambers street, for the best hydraulic rams. First premium.

Cowing & Co., 55 Chambers street, for a railroad tank valve. Honorable mention.

The Rock Valve Manufacturing Co., 15 Gold street, for Rock's ring valve for steam, gas and water. Honorable mention.

Charles F. Hall & Son, 65 Murray street, for the best valve refitting machine. First premium.

William Stamp, Susquehanna Depot, Penn., for a model and drawings of Stamp's non-corrosive joint. Honorable mention.

Patrick Clark, Rahway, N. J., for the best multiplying pressure fan blowers. First premium.

Charles Merrill & Sons, 556 Grand street, for the best pressure blowers. First premium.

P. H. & F. M. Roots, Connersville, Ind., for the best rotary blowers. First premium.

E. Warner and E. E. Darrow, 35 Spruce street, for the best leather hose, hose pipes, etc. First premium.

New York Rubber Co., 5 and 7 Dey street, for the best rubber suction hose and rubber fire hose. First premium.

Newcomb Bros.'s Sons, 586 Water street, for hooped bellows. Honorable mention.

Union Water Meter Co., Worcester, Mass., for an improved method of tapping cement-lined and other pipe. Honorable mention.

George Sewell, Navy yard, Brooklyn, N. Y., for hose couplings. First premium.

Barney Mee, Troy, N. Y., for hose couplings. Second premium.

R. J. Gould, Newark, N. J., for hose couplings. Honorable mention.

DEPARTMENT V.—GROUP 3.

Judges—Messrs. CHARLES T. PORTER, STEPHEN WILCOX.

Union Vise Co., Boston, Mass., for an index milling machine; for a standard milling machine. Honorable mention.

Lucius W. Pond, Worcester, Mass., for an engine turning lathe; for an iron planing machine. Honorable mention.

Lucius W. Pond, Worcester, Mass., for the best hand shearing machines for cutting metals. First premium.

New York Steam Engine Co., 126 and 128 Chambers street, for the best iron planing machine. First premium.

New York Steam Engine Co., 126 and 128 Chambers street, for an upright drill. Second premium.

New York Steam Engine Co., 126 and 128 Chambers street, for an engine lathe, with triple gearing. First premium.

New York Steam Engine Co., 126 and 128 Chambers street, for a car wheel boring machine. First premium.

P. W. Neefus, 231 West street, for a double rachet drill brace. Honorable mention.

G. F. Warner & Co., New Haven, Conn., for malleable iron castings. Honorable mention.

Washburn Machine Shop, Worcester, Mass., for an engine lathe and a speed lathe. First premium.

Charles Merrill & Sons, 556 Grand street, for the best spring forging hammer and a drop hammer. First premium.

Thomas Shaw, Philadelphia, Pa., for a gunpowder forging hammer. Honorable mention.

Lyon & Fellows, 98 and 100 South Sixth street, Brooklyn, E. D., for turned machine screws. Honorable mention.

New York Steam Engine Co., 126 and 128 Chambers street, for a shaping machine. First premium.

Warren Lyon, 796 Greenwich street, for a hand punching press and shear. Honorable mention.

New York Steam Engine Co., 126 and 128 Chambers street, for Wilder's patent foot press. Honorable mention.

New York Steam Engine Co., 126 and 128 Chambers street, for Wilder's patent power press. First premium.

N. C. Stiles, Middletown, Conn., for a power and foot press. Honorable mention

W. H. Hoag, 214 Pearl street, for a bolt cutter. Honorable mention.

Post & Goddard, 109 Liberty street, for taps, dies, reamers and wrenches. Honorable mention.

S. S. Townsend, 31 Liberty street, for Root's portable forge and rotary blower attached. Honorable mention.

American Twist Drill Co., East Blackstone, Mass., for grinding machines mounted with union emery wheels. First premium.

Isaac S. Lauback, Eleventh street and avenue D, for a universal portable drilling machine. First premium.

New York Steam Engine Co., 126 and 128 Chambers street, for an upright drilling machine. First premium.

New York Steam Engine Co., 126 and 128 Chambers street, for a nut facing machine. Honorable mention.

Washburn Machine Shop, Worcester, Mass., for a draughtmans' stand. Honorable mention.

Henry Baker, 580 Hudson street, for Taylor's saw sharpener and deepener. Honorable mention.

Trenton Tool & Vise Co., Trenton, N. J., for wrought solid box vises. Honorable mention.

New York Steam Engine Co., 126 and 128 Chambers street, for a slotting and turning machine. First premium.

Durrie & Rusher, 97 Chambers street, for Tate's wrought iron vise. Second premium.

George W. Hall, 71 Broadway, for McHaffie's direct steel castings. First premium.

C. Vogel, 306 West Thirty-eight street, for a compressed air forge hammer. Honorable mention.

John Bayliss, corner Fifty-fourth street and Lexington avenue, for blacksmiths' tuyere and forge. First premium.

A. P. & M. Stephens & Co., 91 Liberty street, for Stephens' patent vises. First premium.

Post & Goddard, 109 Liberty street, for emery wheels. Honorable mention.

George Place & Co., 126 and 128 Chambers street, for Morse's patent drills, reamers and chucks. First premium.

William Johnson, Lambertville, N. J., for a universal lathe chuck. Honorable mention.

Severance & Holt, 14 and 16 Wall street, for a diamond rock drill. First premium.

E. W. Phelps, Elizabeth, N. J., for a saw gummer and sharpener. First premium.

J. Burns West, Geneseo, N. Y., for West's American tire setter. First premium.

Reuben Brady, 801 Washington street, for a double-action lever press. Honorable mention.

DEPARTMENT V.—GROUP 4.

Judges—Messrs. E. BIERSTADT, GEORGE W. THARPE, A. B. OGDEN.

American Saw Co., 5 Jacob street, for the best saws. First premium.

Edward H. Roe, 54 Newark avenue, Jersey City, N. J., for back saws. Honorable mention.

Eben Moody Boynton, 87 Beekman street, for lightning saws. Honorable mention

Erastus Y. Clark, 282 Spring street, for saw sets. Honorable mention.

Hezekiah B. Smith, Smithville, N. J., for a resawing machine. Second premium.

John B. Schenck & Son, 118 Liberty street, for the best four roll siding saw. First premium.

James S. Nason, 109 Liberty street, for the best band saw. First premium.

Paul Pryibil, 452 to 456 Tenth avenue, for a band sawing machine. Second premium.

John T. Plass, 143 East Thirtieth street, for a band sawing machine. Honorable mention.

Cornelius Van Ness, One Hundred and nineteenth street, Harlem, for band saws and spring. Honorable mention.

John A. Wood, Far Rockaway, N. Y., for the best hand circular saw and rabbeting machine. First premium.

William H. Havens, Paterson, N. J., for the best compound circular saw table. First premium.

William H. Hoag, 214 Pearl street, for a ripping and scroll saw combined. Honorable mention.

Reuben McChesney, Birmingham, Conn., for the best jig or scroll saw. First premium.

Henry Lloyd Beach, 42 John street, N. Y., for scroll sawing machine. Second premium.

Charles Augustus Hoffman, 220 Centre street, for a scroll sawing machine. Honorable mention.

J. P. Grosvenor, Lowell, Mass., J. R. Joslin, agent, 91 Liberty street, New York, for the best double saw bench and single miter saw bench. First premium.

John B. Schenck & Son, 118 Liberty street, for the best improved Schenck-Woodworth planing and matching machine. First premium.

Thomas E. Gaynor, 55 Chambers street, for planes and spokeshaves. Honorable mention.

R. Ball & Co., Worcester, Mass., for a hand boring machine. Honorable mention.

Hezekiah B. Smith, Smithville, N. J., for a blind stile borer. Honorable mention.

First & Pryibil, 452 Tenth avenue, for double spindle boring machine. Honorable mention.

R. Ball & Co., Worcester, Mass., for the best hub mortising machine. First premium.

Hezekiah B. Smith, Smithville, N. J., for a power mortiser. Honorable mention.

Hezekiah B. Smith, Smithville, N. J., for a blind stile mortiser. Honorable mention.

Jonah Newton, 120½ Baxter street, for semicircular mortise tenon and rotary cutter. Honorable mention.

Hezekiah B. Smith, Smithville, N. J., for a No. 2 moulder or sash sticker. Honorable mention.

R. Ball & Co., Worcester, Mass., for the best moulding machine. First premium.

C. E. Brush & Co., 176 Broadway, for Jones' joint and miter plane. Honorable mention.

W. A. Ives & Co., New Haven, Conn., for augers. Honorable mention.

Post & Goddard, 109 Liberty street, for single twist auger bits. Honorable mention.

John B. Schenck & Son, 118 Liberty street, for a side tool set. Honorable mention.

John B. Schenck & Son, 118 Liberty street, for a knife grinder. Honorable mention.

William Thompson, 279 Ninth avenue, for the best tongue and groove cutter and sash, blind and slat cutter. First premium.

Hezekiah B. Smith, 119 Liberty street, New York, and Smithville N. J., for the best No. 2 tenoner, double headed and two copes. First premium.

Henry M. Rogers, 27 Waverly place, Jersey City, N. J., for a tenoning machine. Honorable mention.

R. Ball & Co., Worcester, Mass., for a blind slat tenoning Machine. Honorable mention.

A. McAlpine & Son, Pittston, Pa., for the best labor saving hoop machine. Honorable mention.

Francis D. Green, Williamsport, Pa., for a panel raising machine. Honorable mention.

Jagger & Chase, 121 and 125 East eighty-fourth street, for Arkansas, Washita and Hindoostan oil stones. Honorable mention.

Thomas Douglass, 47 Chambers street, for mechanics' tools. Honorable mention.

James T. Pratt & Co., 53 Fulton street, for gentlemen's tool chest. Honorable mention.

C. Schweitzer, 35 Beekman street, for dividers and calipers. Honorable mention.

Gunpowder Pile Driver Co., Philadelphia, Penn., for the best gunpowder pile driver. First premium.

Thomas Loring, Blackwoodstown, N. J., for machine-made grindstone. Honorable mention.

George L. Cumming, 140 Center street, for an iron grindstone frame. Honorable mention.

H. P. Robinson & Co., Worcester, Mass., for a shingling bracket. Honorable mention.

American Tool Steel Co., 30 Broadway, for the best samples of bar steel. First premium.

American Tool Steel Co., 30 Broadway, for steel tyres. Honorable mention.

DEPARTMENT V.—GROUP 5.

Judges—Messrs. GEORGE H. BABCOCK, M. M. LIVINGSTON, JOSEPH TRENT.

John Good, 515 Grand street, Brooklyn, E. D., for the best machine for spreading flax, hemp, etc. First premium.

Alexander Stevenson, 378 Seventy-fifth street, for a fan carpet cleaning machine. Honorable mention.

Thomas A. Campbell, foot Twenty-third street, North river, for the best wool oiling machine. First premium.

William C. McBride, Somerville, N. J., for the best flax scutching machine. First premium.

C. L. Goddard, 3 Bowling Green, for the best burring picker; for the best worsted burring picker; for the best steel ring solid packing burring machine; for the best double steel ring solid packing burring machine; for the best intersecting steel ring feed rolls; for the best plane steel ring feed rolls for first breakers; for the best plane steel ring feed rolls for second breakers; for the best card cylinder. First premium.

William P. Hopkins, Lawrence, Mass., for the champion picker band for looms and combination step for spindles. Honorable mention.

Jewell & Ehlen, 93 Liberty street, for Shaw's cotton seed huller. First premium.

Jeremiah Stever, Bristol, Conn., for the best improvement in looms for weaving cloth. First premium.

DEPARTMENT V.—GROUP 6.

Judges—Messrs. JOHN MATTHEWS, EDWARD A. RAYMOND, E. P. NEEDHAM.

J. Nottingham Smith, 231 Newark avenue, Jersey City, N. J., for the best brick machine. First premium.

John Jennings, Jr., & Son, Natick, Mass., for shoe knives. Honorable mention.

J. K. Krieg & Co., 44 Warren street, for shoemakers' tools. Honorable mention.

M. & J. Hobbs, East Brookfield, Mass., for Curtis' improved sole cutting machines. First premium.

L. L. Whitlock, Providence, R. I., for a rock drill. Honorable mention.

DEPARTMENT I.—GROUP 7.

Judges—Messrs. JOHN MATTHEWS, EDWARD A. RAYMOND, E. P. NEEDHAM.

James Bogardus, corner White and Elm streets, for a universal eccentric mill for paints, inks and starch. Honorable mention.

James H. Prentiss, 249 West Twenty-eighth street, for a coffee and spice mill. Honorable mention.

Jewell & Ehlen, 93 Liberty street, for a diamond mill. Honorable mention.

Ross Brothers, 85 First street, Brooklyn, E. D., for paint and grain mills. Honorable mention.

John Trageser, 447 to 453 West Twenty-sixth street, for Harris' self-acting mashing machine. Honorable mention.

Reidy & Kiely, 23 Ferry street, for the best oak tanned main leather belt. First premium.

Charles A. Schieren, 92 Gold street, for a main leather belt. Second premium.

Franklin Beames, 89 Cliff street, for leather machine belting. Honorable mention.

Anton Heim, 33 Ferry street, for belting, belt fastener and belt clasp. Honorable mention.

J. B. Suffern & Co., 775 Tenth Avenue, for crank shafts. Honorable mention.

J. S. Tilley, 307 Broadway, for Spencer's motion. Honorable mention.

Ball & Jewell, Greenpoint, L. I., for an improved device for transmitting motion. Honorable mention.

C. H. De Lamater, foot of West Thirteenth street, for teledynamic wheels. Honorable mention.

William D. Russell, 10 Park Place, for Baxter's adjustable S and diagonal wrenches Honorable mention.

William Taphouse, 239½ Ninth avenue, for moulders' and plasterers' tools. Honorable mention.

S. Stow Manufacturing Co., Plantsville, Conn., for tinsmiths' machines. Honorable mention.

L. L. Davis, Springfield, Mass., for levels. Honorable mention.

Jesse L. Law, 55 Chambers street, for a dynamometer balance wheel. Honorable mention.

William P. Hopkins, Lawrence, Mass., for the excelsior caliper and friction adjusting nut for small tools. Honorable mention.

Michael Hastings, 27 John street, for pipe wrenches. Honorable mention.

Jones & Laughlin, Pittsburgh, Pa., for cold rolled shafting. Honorable mention.

Judges at Large—Messrs. JOHN MATTHEWS, O. M. TINKHAM, CHAS. F. MUDGE.

Albert F. Allen, Providence, R. I., for Allen's patent mechanics' wrenches. Honorable mention.

VI.—DEPARTMENT OF INTERCOMMUNICATION.

FIRST GROUP.—Locomotive engines, cars, or models of the same, and all apparatus used in constructing and operating railways, models of bridges, etc.; all fixtures, furniture and appliances used on passenger and freight railway cars.

SECOND GROUP.—Carriages, wagons, sleighs, and all vehicles drawn by animal power; harness, saddles, bridles, and all apparatus used in connection with the horse and the stable; specimens of improved material for making common roads and pavements, and all apparatus used in constructing the same and keeping them in repair.

THIRD GROUP.—Models of vessels for navigating the ocean, rivers, lakes and canals; all apparatus connected with building, propelling and steering vessels; models of locks, docks, aqueducts; structures and implements used in navigation.

FOURTH GROUP.—Electric telegraphs, apparatus used in constructing overland and submarine telegraph lines; all apparatus for giving signals and alarms, bells, etc.; implements and contrivances used in transporting and distributing mails; package express, and implements connected therewith; hand machines, materials and implements used in printing, engraving and advertising.

FIFTH GROUP.—Fire engines and apparatus used in extinguishing fires; fire escapes; apparatus used in making and conveying illuminating gas for towns and cities; gas meters; apparatus for supplying towns and cities with water; water meters.

SIXTH GROUP.—Implements for expediting trade; contrivances used in the store and warehouse; scales; locks for stores and banks; safes, hoisting apparatus, shutters, vault lights, reflectors, and iron columns, etc.; specimens of ledgers, account books, blank books, tickets, tags, cards; business flags; glass and other ornamental signs; figure signs.

SEVENTH GROUP.—Army apparatus used in movements or in camp; flags, guns, pistols, swords; models of fortifications; apparatus used in the navy; articles and devices for school buildings and grounds; useful and ornamental work and devices for churches and cemeteries; articles and implements used on public works, not elsewhere designated.

DEPARTMENT VI.—GROUP 1.

Judges—Messrs. DAVID G. STARKEY, A. K. RYDER, EDWIN S. TAYLOR.

George J. Harris, 46 South Eighth street, Brooklyn, E. D., for a nut lock. Honorable mention.

Robert A. Chesebrough, 157 East Sixty-third street, for an elevated railway. Honorable mention.

George C. Thomas, 94 Grand street, for patent safety baggage checks. Honorable mention.

George P. Rose, 132 Broadway, for the best railway and rail splice and chair combined. First premium.

A. A. Daly, 218 Fulton street, for a safety car step. Honorable mention.

The Convolute Car Wheel Co., New Haven, Conn., for car wheels. Honorable mention.

New York Rubber Co., 5 and 7 Dey street, for rubber car springs. Honorable mention.

Walker V. Pulliam, Kansas City, Mo., for the American car coupler. First premium.

Radley & McAllister Manufacturing Co., 21 Cortlandt street, for locomotive headlights. First premium.

DEPARTMENT VI.—GROUP 2.

Judges—Messrs. J. ELLIOTT CONDIT, HENRY T. PRATT, EDWARD KILPATRICK.

Rufus M. Stivers, 144 to 152 East Thirty-first street, for a eureka cutter; for a Dexter cutter; for an adjustable seat wagon; for a jaggar top wagon; for a Hambletonian road wagon, and a side bar road wagon. First premium.

J. B. Brewster & Co., 65 East Twenty-fifth street, for a road wagon. Second premium.

J. B. Brewster & Co., 65 East Twenty-fifth street, for a dog cart. Honorable mention.

John C. Ham, 20 East Fourth street, for a six-seat circular Clarence front rockaway carriage, and an improved pattern landaulette. Honorable mention.

Theodore E. Baldwin & Co., 786 Broadway, for a carriage (Coupe). Honorable mention.

Edward Smith, White Plains, N. Y., Joseph L. Smith, agent, 28 East Twenty-ninth street, New York, for a light road wagon. Honorable mention.

Thomas G. Stagg, East New York, for a folding carriage for children. Honorable mention.

Andrew Christian, 65 Maiden Lane, New York, for childrens' carriages, sleighs and perambulators. Honorable mention.

Crandall & Co., 562 Third avenue, for children's charriages, spring horses, sleighs, chair rockers, and propellers. Honorable mention.

Novelty Carriage Co., 805 East Sixth street, for a carriage cradle and baby jumper combined. Honorable mention.

Hershey, Geer & Dudley, Erie, Pa., for a dump cart and bolster with patent springs. First premium.

Alfred E. Smith, Bronxville, N. Y., for carriage axles. Honorable mention.

Ætna Axle and Spring Co., Bridgeport, Conn., for elliptic and C springs. Honorable mention.

Lambertville Spoke Manufacturing Co., Lambertville, N. Y., for finished carriage spokes. Honorable mention.

Vollum & Green, 96 to 104 North Moore street, for a carriage wheel lubricator. Honorable mention.

Ephraim Soper, 314 East Twenty-sixth street, for carriage hardware. Honorable mention.

The Climax Horse Collar Co., 33 Barclay street, for horse collars of wood and flaxhorn. First premium.

American Horse Collar Co., 100 Milk street, Boston, Mass., for rubber lined collars, saddles, pads and halters. Honorable mention.

Edward Griswold, 6 State street, for an equalizing whiffle-tree. Honorable mention.

John R. Achenback, Saddle river, N. J., for a rein-holder. Honorable mention.

J. V. Waldron, 46 Beekman street, for harness ornaments. Honorable mention.

Sargeant Manufacturing Co., 179 Broadway, for Cole's wedge tongue trace buckle, with Kay's improvement. Honorable mention.

Bradhurst Schieffelin, 13 East Twenty-sixth street, for the Dexter wagon thill coupling. Honorable mention.

Hawley, McClure & Co., Utica, N. Y., for wagon skeins, boxes and bolster plates. Honorable mention.

Globe Nail Co., Boston, Mass., E. R. Sawin, general agent, P. O. box 1891 Boston, Mass., for horse shoe nails. Honorable mention.

Alfred Woodham, 448 Broome street, for Doughty's hoof cushions. Honorable mention.

Samuel S. Bent, 408 to 422 East Twenty-sixth street, for poultry yard and stable fittings. Honorable mention.

James L. Jackson & Bro., Twenty-eighth and Twenty-ninth streets and Second avenue, for stable fittings. Honorable mention.

William M. Bleakley, Verplank, N. Y., for a patent stall floor. Honorable mention.

Moore Steel Elastic Car Wheel Co., Jersey City, N. J., for Moore's steel elastic car wheel. Honorable mention.

Hayden & Letchworth, Auburn, N. Y., for light coupling for light wagons, top prop, stump joint ends and slotted fifth wheel, all of wrought iron. Honorable mention.

E. & B. Holmes, Buffalo, N. Y., for a patent dumping wagon. First premium.

Rutter & Simmons, 8 Ferry street, for the best fancy leather. First premium.

DEPARTMENT VI.—GROUP 3.

Judges—Messrs. WM. W. W. WOODS, R. G. MCDOUGALL, W. L. HANSCOM.

W. W. Vanderbilt, 569 Broadway, for models of vessels, drawings and plates of engines. First premium.

J. P. Curry, 231 West street, for models of a tubular frame ship. Honorable mention.

Richard P. H. Abell, 231 East Thirteenth street, for model of a sloop yacht. Honorable mention.

Thomas P. Akers, box 6138, P. O., for the best leakage alarm indicator. First premium.

George W. Browne, 110 Wyckoff street, Brooklyn, N. Y., for patent automatic noiseless rowlocks. Honorable mention.

E. W. Page, 69 West street, for oars and sculls. Honorable mention.

Frederick Wittram, 532 Broadway, for model of an anchor. Honorable mention.

James L. Jackson & Bro., Twenty-eight and Twenty-ninth streets and second avenue, for the best steering apparatus. First premium.

John Reinholt Anderson, 209 South Third street, Brooklyn, E. D., for fog alarms. Honorable mention.

John Rider, 18 West Twenty-fourth street, for the best life-saving raft. First premium.

DEPARTMENT VI.—GROUP 4.

Judges—Messrs. L. L. SMITH, L. BRADLEY, W. A. SHELDEN.

Edwin D. McCracken, 617 Sixth avenue, for alternating batteries with switches and telegraph apparatus. First premium.

American Printing Telegraph Co., 80 Broadway, for the best electric printing telegraph instruments. First premium.

Emile Prevost, 57 Carmine street, for improvements in liquids for electric batteries. Honorable mention.

W. H. Rodgers, 45 Liberty street, for a burglar alarm. Honorable mention.

James Gregory, 112 to 116 Cannon street, for a mounted gong. Honorable mention.

Suitterlin, Claassen & Co., Chicago, Ill., for the best chromatic printing press. First premium.

C. C. Thurston, 16 College place, for a novelty job printing press. Second premium.

E. A. Calahan, 18 New street, for telegraph instruments. First premium.

Chas. Williams, Jr., Boston, Mass., for electrical instruments. Honorable mention.

William Robinson, Petroleum Center, Penn., for electro-magnetic railway signals. Honorable mention.

Department VI.—Group 5.

Judges—Messrs. Wesley Smith, Chas. B. Bostwick, D. B. Depierris.

James Cochrane, 64 West Tenth street, for a water meter. Honorable mention.

Albert F. Allen, Providence, R. I., for fire department supplies. Honorable mention.

Judges at large—Messrs. John Matthews, O. M. Tinkham, Chas. F. Mudge.

Clapp & Jones Manufacturing Co., Hudson, N. Y., for a steam fire-engine. First premium.

Post, Herkner & Co., 19 Murray street, for Chaffees, rubber lined linen fire hose. First premium.

Department VI.—Group 6.

Judges—Messrs. Thomas W. Chandler, J. L. Brown.

Ellison & Co., 3 Park place, for the best hay and coal scale. First premium.

Riehle Bros., Ninth street, Philadelphia, Penn., William R. Cock, Agent, 85 Liberty street, New York, for the best stock house scale. First premium.

Riehle Bros., Ninth street, Philadelphia, Penn., William R. Cock, Agent, 85 Liberty street, New York, for a rolling mill scale. Honorable mention.

C. H. Phelps & Co., 98 Broadway, for an arc scale. Honorable mention.

J. W. Kissam, 81 Fulton street, for a tea scale. Honorable mention.

John P. Gruber, 182 Chatham street, for a diamond scale and a bank scale. Honorable mention.

William P. Pierce, 20 Pell street, for prescription, analytical and gold scales Honorable mention.

Joseph Hollely, 14 Hicks street, Brooklyn, N. Y., for the eureka balance scales. Honorable mention.

Riehle Bros., Ninth street, Philadelphia, Penn.; William R. Cock, agent, 85 Liberty street, New York; for a compound parallel crane beam. Honorable mention.

John C. Smith, 124 Clinton street, Brooklyn, N. Y., for an electro-magnetic lock. Honorable mention.

T. B. Worrall, Frankfort, Penn., for a bank lock. Honorable mention.

S. Haviland & Son, 259 Pearl street, for coffee mills and grinding plates. Honor able mention.

Graham & Haines, 77 Chambers street, for a coffee and spice mill. Honorable mention.

William H. Goodwin & Co., 209 Water street, for a segar bunching machine. Honorable mention.

Henry W. Safford, 111 Broadway, for a protective stamp. Honorable mention.

Heath & Smith Manufacturing Co., 44 Murray street, for Adams' air cylinder graining machine. Honorable mention.

Mason Manufacturing Co., New Brunswick, N. J., for sheet metal screws Honorable mention.

James N. Whitfield & Son, 262 Water street, for an eight pull ale pump. Honorable mention.

Graham & Haines, 77 Chambers street, for a hollow bung hole auger. Honorable mention.

Horace A. Palmer, Rochester, N. Y., for coal screen scoops, Honorable mention.

R. H. Allen & Co., 191 Water street, for a dry goods truck. Honorable mention.

Otis Brothers & Co., 309 Broadway, for Otis' safety passenger elevator. First premium.

Merrick & Sons, Philadelphia, Penn.; Solon Farrer, agent, 212 Grand street, New York; for a hoisting apparatus with Seller's attachment. Second premium.

William D. Andrews & Co., 414 Water street, for a portable hoister and a differential geared hoister. First premium.

Felix P. Canfield, 71 Sudbury street, Boston, Mass., for the best hand elevator. First premium.

Mechanics' and Builders' Hoisting Machine Co., 1395 Broadway, for a mason's elevator. Honorable mention.

Hinton & Furney Bros., 552 to 556 West Twenty-seventh street, for a builders' derrick. Honorable mention.

Graham & Haines, 77 Chambers street, for a measuring faucet. Honorable mention.

P. M. Sherwood, 85 Liberty street, for an automatic duplex faucet. Honorable mention.

John J. Bockee, Jr., 37 Dey street, for a measuring oil tank. Honorable mention.

Henry F. Lawrence, Vallejo, Cal., for an improved funnel. Honorable mention.

Cooper, Hewitt & Co., 17 Burling Slip, for sections of rolled wrought iron beams. Honorable mention.

Hojer & Graham, 97 Duane street, for an open work street banner. Honorable mention.

T. Shriver & Co., 333 East Fifty-sixth street, for letter-copying presses and brushes, of the first order of merit. One of the firm being a manager of the fair, is debarred from the receiving a premium.

William H. Core, 133 Chatham street, for a show case. Honorable mention.

George Sidey, 16 Duffield street, Brooklyn, N. Y., for a sifting machine. Honorable mention.

Judges at Large—Messrs. John Matthews, O. M. Tinkham, Chas. F. Mudge.

J. P. Travers & Son, 46 Beekman street, for samples of twine, fiber and cordage. Honorable mention.

Department VI.—Group 7.

Judges—Messrs. Alexander Shaler, Charles K. Graham, Whitman V. White.

Penrhyn Slate Co., 40 West Eighteenth street, for a marbleized slate altar. First premium.

Paul A. Oliver, 345 West Twenty-first street, for the best bayonet fastening. First premium.

Ward Burton Breech-loading Fire Arms Co., 54 Wall street, for the best breech-loading rifle. First premium.

John J. Tower, 4 Warren street, for handcuffs and leg shackles. Honorable mention.

J. W. Storrs & Co., 252 Broadway, for the best pocket rifles. First premium.

M. W. Robinson, 70 Chambers street, for F. Wesson's sporting and pocket rifles. Honorable mention.

C. Remington & Sons, Ilion, N. Y., for the best guns and pistols. First premium.

Smith & Wesson, Springfield, Mass., M. W. Robinson, agent, 79 Chambers street, for the best revolvers. First premium.

Colt's Fire Arms Manufacturing Co., Hartford, Conn., Charles H. Pond, agent, 179 Broadway, for the Gatling cannon. First premium.

Winchester Repeating Fire Arms Co., New Haven, Conn., Charles H. Pond, agent, 179 Broadway, for the best repeating fire arms. First premium.

Peter Bourdereaux, 23 New Chambers street, for the best breech-loading double barrel guns. First premium.

Wesson Fire Arms Co., Springfield, Mass., J. W. Storrs & Co., agents, 252 Broadway, for double barrel breech-loading guns. Honorable mention.

H. Julius Smith, Boston, Mass., for the best electric battery, and battery fuses. First premium.

VII.—DEPARTMENT OF AGRICULTURE AND HORTICULTURE.

First Group.—Plants and flowers.

Second Group.—Fruits, vegetables, cereals, roots and seeds.

Third Group.—Food prepared on the farm, butter, cheese, etc.

Fourth Group.—Ploughs, diggers, cultivators, harrows, drain-pipe, and implements used in preparing the soil; pruning knives, and all implements for cultivating plants and trees; hot house apparatus.

Fifth Group.—Mowers, reapers, scythes, and implements used in gathering the products of the soil. Threshing machines, corn shellers, grain and other farm mills.

Sixth Group.—Churns, cheese presses, and all articles used in dairy, farm house, and farm stable, not elsewhere enumerated.

Seventh Group.—Products of the soil used in the arts. Wood, hemp, flax, cotton, etc. Products of animal growth; wool, silk, hair, feathers, down, horn, bone. Live animals, whenever the board of managers shall decide to admit them.

Department VII.—Group 1—(*First Series*).

Judges—Messrs. William L. Ferris, Isaac Buchanan.

William Baker, Forty-second street and Second avenue, for the best collection of miscellaneous plants of house culture. First premium.

William Baker, Forty-second street and Second avenue, for four specimen plants in bloom. Honorable mention.

William Baker, Forty-second street and Second avenue, for a single specimen plant. Honorable mention.

William Baker, Forty-second street and Second avenue, for six varieties of variegated leaved plants. Honorable mention.

William Baker, Forty-second street and Second avenue, for a specimen of tea plant. Honorable mention.

William Baker, Forty-second street and Second avenue, for a specimen of coffee plant. Honorable mention.

William Baker, Forty-second street and Second avenue, for a collection of named orchids in bloom. Honorable mention.

C. L. Allen & Co., 74 Fulton street, Brooklyn, N. Y., for a display of miscellaneous named cut flowers. Honorable mention.

C. L. Allen & Co., 74 Fulton street, Brooklyn, N. Y., for the best display of named gladioli, and the best display of named lilies. First premium.

W. A. Burgess, Glen cove, L. I., for the best display of named cut roses. First premium.

Department VII.—Group 1—(*Second Series*).

Judges—Messrs. Wm. L. Ferris, Henry S. Williams.

George Such, South Amboy, N. J., for the best general collection of variegated leaved plants. First premium.

George Such, South Amboy, N. J., for the best collection of ferns and lycopodiums. First premium.

Isaac Buchanan, Astoria, L. I., for a collection of named orchids in bloom. Honorable mention.

Isaac Buchanan, Astoria, L. I., for named orchids in bloom. Honorable mention.

C. L. Allen & Co., 74 Fulton street, Brooklyn, N. Y., for a display of miscellaneous named cut flowers. Honorable mention.

W. A. Burgess, Glen cove, L. I., for a display of named cut roses. Honorable mention.

Hauft, Bros., 695 Broadway, for the best basket of flowers. First premium.

George Such, South Amboy, N. J., for the best collection of miscellaneous plants of house culture. First premium.

Isaac Buchanan, Astoria, L. I., for four specimen plants in bloom. Honorable mention.

Isaac Buchanan, Astoria L. I., for the best single specimen plant. First premium.

George Such, South Amboy, N. J., for a single specimen plant. Honorable mention.

George Such, South Amboy, N. J., for the best six varieties of variegated leaved plants. First premium.

A. G. Burgess, East New York, L. I., for a display of named dahlias. Honorable mention.

C. S. Pell, Seventy-fourth street and Broadway, for a display of named dahlias. Honorable mention.

C. L. Allen & Co., 74 Fulton street, Brooklyn, N. Y., for the best display of named gladioli and lilies. First premium.

Department VII.—Group 1—(*Third Series*).

Judges—Messrs. James Fleming, David Foulis.

Isaac Buchanan, Astoria, L. I., for the best single specimen plant. First premium·

George Such, South Amboy, N. J., for six varieties of variegated leaved plants. Honorable mention.

George Such, South Amboy, N. J., for a general collection of variegated leaved plants. Honorable mention.

George Such, South Amboy, N. J., for a general collection of ferns and lycopodiums. Honorable mention.

Isaac Buchanan, Astoria, L. I., for a specimen of coffee plant. Honorable mention.

C. S. Pell, Seventy-fourth street and Broadway, for a display of dahlias. Honorable mention.

Walter L. Reid, Thirty-fourth street and Broadway, for a basket of flowers. Honorable mention.

J. N. Hauser, Sixty-sixth street, between First and Second avenues, for a pair of bouquets. Honorable mention.

J. N. Hauser, Sixty-sixth street, between First and Second avenues, for a bouquet. Honorable mention.

J. M. Koehler, First avenue and Thirtieth street, for the best parlor or Wardian cases containing plants. First premium.

George Such, South Amboy, N. J., for a collection of miscellaneous plants of house culture. Honorable mention.

George Such, South Amboy, N. J., for four specimens plants in bloom. Honorable mention.

C. L. Allen & Co., 74 Fulton street, Brooklyn, N. Y., for a display of named gladioli. Honorable mention.

DEPARTMENT VII.—GROUP 1.

Miscellaneous collections entered during the month of October.

J. N. Hauser, Sixty-sixth street, between First and Second avenues, for a basket of flowers. Honorable mention.

C. S. Pell, Seventy-fourth street and Broadway, for a display of miscellaneous named cut flowers, a display of dahlias and bouquet dahlias. Honorable mention.

Klunder & Long, 904 Broadway, for a basket of flowers. Honorable mention.

DEPARTMENT VII.—GROUP 2.

Judges—Messrs. W. W. WILLIAMS, WM. A. BURGESS, ISAAC BUCHANAN.

W. L. Ferris, Throg Necks, N. Y., for a collection of pears, not less than fifty named varieties. Honorable mention.

E. & J. C. Williams, Montclair, N. J., for twelve named varieties of pears. Honorable mention.

F. W. Carpenter, Rye, Westchester county, N. Y., for a collection of apples not less than fifty named varieties. Honorable mention.

F. W. Carpenter, Rye, Westchester county, N. Y., for a collection of apples not less than twenty-five varieties. Honorable mention.

F. W. Carpenter, Rye, Westchester county, N. Y., for a collection of apples twelve named varieties. Honorable mention.

F. W. Carpenter, Rye, Westchester county, N. Y., for six named varieties of apples. Honorable mention.

John F. Seaman, Kingsbridge, N. Y., for six named varieties of grapes grown under glass. Honorable mention.

John F. Seaman, Kingsbridge, N. Y., for a single bunch of grapes grown under glass. Honorable mention.

S. B. Conover, Middletown, N. J., for six named varieties of water-melons. Honorable mention.

S. B. Conover, Middletown, N. J., for the largest and perfectly filled water-melon. Honorable mention.

S. B. Conover, Middletown, N. J., for six muskmelons. Honorable mention.

Ellwanger & Barry, Rochester, N. Y., for a collection of fruit. Honorable mention.

John W. Bailey & Co., Plattsburgh, N. Y., for a collection of apples. Honorable mention.

A. G. Burgess, East New York, N. Y., for seedling apple. Honorable mention.

Ellwanger & Barry, Rochester, N. Y., for a collection of plumbs, twenty varieties. Honorable mention.

Stephen Hoyt & Sons, New Canaan, Conn., for the Van Buren golden dwarf peach. Honorable mention.

Oliver Hoyt, Stamford, Conn., for hothouse grapes. Second premium.

Pleasant Valley Wine Co., Hammondsport, N. Y., for twenty varieties of grapes. Honorable mention.

J. Rutter, Florin, Cal., for a fine exhibition of California grapes. Honorable mention.

H. B. Rathbun, Millpoint, N. Y., for the Ontario grapes. Honorable mention.

J. H. Babcock & Co., Lockport, N. Y., for the Salem grapes. Honorable mention.

John W. Bailey & Co., Plattsburgh, N. Y., for six varieties of grapes. Honorable mention.

R. T. Underhill, 139 East Eighth street, for six varieties of grapes. Honorable mention.

L. M. Ferris & Son, Poughkeepsie, N. Y., for white grapes. Honorable mention.

Hasbrouck & Bushnell, Iona Island, N. Y., for Eumelan grapes. Honorable mention.

S. W. Underhill, Croton Point, N. Y, for seedling grapes, Croton. Honorable mention.

Abraham Way, Johnsonville, N. Y., for six varieties of grapes. Honorable mention.

S. Springstead, Unionport, N. Y., for six varieties of peaches. Honorable mention.

John Cranston, Hoboken, N. J., for seedling peaches. Honorable mention.

Webber & Colt, 26 Vesey street, for six water-melons. Honorable mention.

R. A. Leonord, Middletown, N. J., for five water-melons. Honorable mention.

Reisig & Hexamer, New Castle, N. Y., for the best 300 varieties of potatoes. First premium.

S. Springstead, Unionport, N. Y., for ten varieties of potatoes. Second premium.

S. Springstead, Unionport, N. Y., for the best bushel of potatoes, "Early Rose." Second premium.

S. Springstead, Unionport, N. Y., for thirty-five varieties of seedling potatoes. Honorable mention.

S. Springstead, Unionport, N. Y., for the best sweet potatoes. Second premium.

Henry P. Carlson, Vineland, N. J., for sweet potatoes. Honorable mention.

John Sutton, Islip, L. I., for sweet potatoes, "Southern Queen." Honorable mention.

Theodore Schultz, Astoria, L. I., for sweet potatoes. Honorable mention.

S. Springstead, Unionport, N. Y., for the best sweet corn. Honorable mention.

J. M. Greeley, English Neighborhood, N. J., for the best field corn. Honorable mention.

William H. Archer, Jerome, Westchester Co., N. Y., for cheese tomatoes. Honorable mention.

John Van Winckel, Newtown, L. I., for lima beans. Honorable mention.

DEPARTMENT VII.—GROUP 4.

Judges—Messrs. JOSIAH H. MACY, C. G. CRANE.

Ames Plow Co., 53 Beekman street, for the best steel plow wheel and cutter. First premium.

Ames Plow Co., 53 Beekman street, for a hardened steel plow. Second premium.

Griffing & Co., 58 and 60 Cortlandt street, for the "Mohawk Valley Clipper," steel plow. Honorable mention.

Ames Plow Co., 53 Beekman street, for an improved patent hardened steel plow. Honorable mention.

Griffing & Co., 58 and 60 Cortlandt street, for an improved shovol plow. Honorable mention.

Ames Plow Co., 53 Beekman street, for a cast-iron plow. Honorable mention.

Ames Plow Company, 53 Beekman street, for a telegraph cast-iron plow wheel and cutter. Honorable mention.

H. M. Basford & Co., 431 West Fourteenth street, for pipe and drain tiles combined. Honorable mention.

Norris & Miller, 229 East Forty-first street, for vitrified stone drain and sewer pipe. Honorable mention.

Griffing & Co., 58 and 60 Cortlandt street, for a copper strip cutter. Honorable mention.

E. D. & O. B. Reynolds, North Bridgewater, Mass., for a No. 2 eagle seed sower with hill dropping attachment. Honorable mention.

R. H. Allen & Co., 191 Water street, for Cahoon's broadcast hand seed sower. Honorable mention.

Griffing & Co., 58 and 60 Cortlandt street, for a pulverizing harrow. Honorable mention.

J. A. Swenarton, Spring Valley, N. Y., for a self-cleaning harrow. Honorable mention.

Griffing & Co., 58 and 60 Cortlandt street, for the best solid steel tooth cultivator. First premium.

Ames Plow Co., 53 Beekman street, for Knox's steel horse hoe. Honorable mention.

George W. Bruce, 1 Platt street, for solid cast-steel hoes and tools. Honorable mention.

E. D. & O. B. Reynolds, North Bridgewater, Mass., for a clipper wheel hoe. Honorable mention.

S. B. Conover, 407 West Forty-seventh street, for the best potato planter and cultivator. First premium.

E. H. Reeves & Co., 185 and 187 Water street, for Hall's potato digger. Honorable mention.

R. H. Allen & Co., 191 Water street, for a "cephydrion," for watering gardens. Honorable mention.

R. H. Allen & Co., 191 Water street, for the "little giant" stump puller. Honorable mention.

B. K. Bliss & Son, 23 Park place, for seeds and garden requisites. Honorable mention.

DEPARTMENT VII.—GROUP 5.

Judges—Messrs. JOSIAH H. MACY, C. G. CRANE.

Frank Bramer, Little Falls, N. Y., for Black's hay conveyor. Honorable mention.

William H. Field, Port Chester, Westchester county, N. Y., for a mowing machine cutter. Honorable mention.

DEPARTMENT VII.—GROUP 6.

Judges—Messrs. JOSIAH H. MACY, C. G. CRANE.

Solomon Oppenheimer, Newark, N. J., for a safety milking pail. Honorable mention.

George Miller Sternberg, 19 Platt street, for the excelsior family fruit drier. Honorable mention.

Ames Plow Co., 53 Beekman street, for the little giant wheel jack. Honorable mention.

Smith, Priest & Earl, Jr., Nashua, N. H., for the American horse clipping and sheep shearing machine. Honorable mention.

R. H. Allen & Co., 191 Water street, for the New York feed cutter. Honorable mention.

A. H. Bryant, Chicago, Ill., for a corn husker. Honorable mention.

R. D. Mann, 119 Nassau street, for animal, fowl, and fish traps. Honorable mention.

R. H. Allen & Co., 191 Water street, for the Blanchard churn. Honorable mention.

DEPARTMENT VII.—GROUP 7.

Judges—Messrs. JOSIAH H. MACY, C. G. CRANE.

Lister Brothers, Newark, N. J., for bone. Honorable mention.

Homer A. King & Co., 240 Broadway, for the American bee hives. Honorable mention.

Hay Cutting & Baling Co., foot West Eleventh street, for cut, crushed, and winnowed hay. Honorable mention.

A. Eutychides, Owing's Mills, Baltimore Co., Md., for Angora goats. Honorable mention.

EXTRACTS

FROM

REPORTS OF JUDGES AT THE EXHIBITION OF 1870.

From the numerous able reports of judges of the merits of articles exhibited, the following are selected:

No. 732—The Allen Engine.

Allen Engine Works, 4th Av. and 130th St., New York City.

The performance of this engine has exceeded that of the two fine engines which were on trial here last year. The results seem to be without precedent in such engines. The engine ran from eleven to twelve hours repeatedly without showing a sign of a warm bearing, displaying thorough perfection in all its parts. In all respects the engine is first-class, and from the fact of its presenting weight with speed, as a requisite for perfection in steam engines, it has opened a new era in this necessary branch, its economy having been clearly demonstrated in the careful trials, which ought to be published in full.

F. A. P. BARNARD,
THOS. J. SLOAN,
ROBERT WEIR,
Judges.

Test of Steam Engine on Exhibition.

Rooms of the American Institute, New York City,
December 15, 1870.

To F. A. P. Barnard, S. T. D., LL.D., Thomas J. Sloan, Esq., and Robert Weir, Esq., *Judges of Group* 1, *in Department V., of the Exhibition of the American Institute*, 1870:

Gentlemen.—I hereby submit a report of the experiments conducted, in pursuance of your instructions, for the purpose of ascertaining the economy and effective power of the Allen engine, shown at this exhibition, with the diagrams taken on such trials, and a drawing of the apparatus employed.

No means had been provided for measuring the effective power of the engine, and the arrangement of the shaft and pully did not permit the introduction of a dynamometer for this purpose. It was, however, considered, especially on account of the high speed at which this engine was run, to be of the first consequence that its effective power should be ascertained, and a trial with the friction brake seemed the only practicable method of ascertaining it.

But, although this instrument was very suitable for exhibiting the relation between the indicated and the effective power of the engine, I did not think it could be relied upon to afford a constant resistance through a protracted trial of so large an engine for economy.

It was, therefore, determined to conduct two separate experiments; the first, for the purpose of ascertaining the consumption of coal per hour required for each one horse-power of work done by the steam in the cylinder, as shown by the indicator diagrams; and the second, to ascertain the per centage of its indicated power that the engine was able to give off in useful effect.

The first of these experiments was conducted on the 3d of November, the engine driving the machinery of the exhibition increased, as far as possible, by the addition of two pumps and two large blowers. The next day the belt was removed, and the friction brake was adjusted to the band-wheel of the engine for the second trial. It was not got in readiness for use, however, until the afternoon of the 5th, the closing day of the fair, and was then found to be imperfect, and the hurried experiment that was tried showed only the necessity of a greater degree of care and thoroughness in the preparation than was then possible. After the close of the exhibition, therefore, this trial was repeated, on the 18th and 19th days of November, under my personal supervision, in as public a manner as possible, and in the presence of two of your number, and of four of the managers of the Institute, and it was of a character calculated to inspire entire confidence in its results.

The two trials will be described and their results given separately.

Dimensions and Particulars of the Engine.

Diameter of cylinder	16.	ins.
Length of stroke..	30.	"
Revolutions per minute....................................	125.	
Mean piston speed in feet per minute	625.	
Foot pounds of work done per minute in the cylinder, for each one pound of mean pressure................	125,662.5	

Horse-powers exerted in the cylinder, for each one pound of mean pressure...........................	3.808
Waste room in clearance and passages (cubic inches)...	248.
Proportion added thereby to the piston displacement ..	.0411
Length added thereby to the stroke (in inches)........	1.23
Diameter of fly-wheel, in feet	9.
Weight of fly-wheel (pounds)	7,800.

The engine has four valves, one for admission, and one for release at each end of the cylinder.

All the valves are driven from a link worked by one eccentric.

Total throw of eccentric two and one-half inches.

The admission valves are driven from the movable block, adjusted by the action of the governor.

The cut-off is variable, by this automatic action, from the commencement up to the half-stroke.

The exhaust valves are driven from a fixed point at the extemity of the link.

The valves are equilibrium slide valves.

Each admission valve opens four passages into one port. Aggregate length of the four openings, thirty-six inches. Width of each opening, when the steam is cut off at one-fourth of the stroke, one-fourth of an inch; when cut off at half stroke, five-eighths of an inch.

Area of admission port, $9+1\frac{1}{2}$ inches$=13\frac{1}{2}$ square inches.

Diameter of steam pipe, six inches.

Each exhaust valve opens two passages.

Area of exhaust port and passages, twenty square inches.

Diameter of exhaust pipe, first length and elbow seven inches, remainder eight inches.

The steam was released at 27.5 inches of the stroke, and compression began at twenty-eight inches of the return stroke.

The cylinder was not steam jacketed, except on one side by the valve chest. On the exhaust side, a belt was interposed to protect it externally from the colder exhaust current. The cylinder was covered with boiler cement cased in wood lagging, except the steam chest, which was polished. The heads were double, and polished. The engine was supplied with steam from the Allen boiler, which, by carrying the water at the middle of the horizontal pipes, superheated the steam in a slight degree.

The steam pipe was well covered with boiler cement.

First Trial.

Following the precedent of last year, the water test only was used, and the consumption of coal is calculated, on the assumption that one pound of coal burned evaporated nine pounds of water.

The boiler was supplied from the tank which had been used for the boiler experiments, and which had a capacity of twenty-five cubic feet. It was filled by a four-inch hose from the fire-plug on the avenue.

The time occupied in filling the tank was less than a minute, and during this operation the outlet to the feed pump was closed.

The volume of steam accounted for by the indicator has been ascertained as follows: The capacity of the cylinder at the instant of release was found by adding to the stroke (thirty inches), the waste-room (1.23 inches), and subtracting the distance from the termination at which the exhaust port was opened (2.5 inches), giving a length of 28.73 inches. The engine was credited for each stroke with this volume of steam at the terminal pressure (14.345 pounds). It was then charged with the steam confined by the closing of the exhaust, which filled a length of (2 + 1.23) 3.23 inches, at a density of 15.8 pounds.

The calculation made on this basis gives a consumption per hour of 43,963 cubic feet of steam, at the pressure of 14.345 lbs. This volume, multiplied by the decimal .0358, the weight in decimals of a pound, of one cubic foot of steam at that pressure, gives 1,573.87 lbs. of water accounted for per hour, or 92.36 per cent of the water evaporated.

It was made impossible for any water to enter the boiler, except that drawn from the tank, and all the steam generated, except that taken by the feed pump as hereafter mentioned, was worked through the engine.

The engine was run continuously for eleven hours, from 11 A. M. to 10 P. M., with two interruptions.

The first was at 2.30 P. M., for putting on a belt, and lasted only two minutes; the second was at six o'clock, to permit an exhibitor to make some connections, and was protracted to twenty minutes. It was not expected, however, to be more than momentary and we were hoping every minute to start again. The boiler was not thought of until it was heard blowing off with a pressure in the pipe of over 100 lbs., making it necessary to open also the three-quarter-inch drain pipe from the main steam pipe. The exhibitors claimed that the loss of steam was certainly quite as much as the engine would have used if running, and as I found that the tank then emptying lasted a shorter time by three minutes than the next one did, I have thought it right to allow the claim. No account of the stoppage is, therefore, made.

No counter was employed but the engine was timed occasionally, and was always at its full speed of 125 revolutions; if inexact at all, it was in excess of this speed.

A barometer was not used, the pressure of the atmosphere is assumed at 30.154 inches of mercury, or 14.8 lbs. on the square inch.

The boiler had been supplied by a steam pump. For this trial, arrangements were made to feed it by a pump driven from the shaft, so that all the water sent into the boiler would be worked through the engine, as it was on the trials last year. Unluckily, this pump gave out entirely on the morning of the trial, and the steam pump had to be used all day. No allowance is attempted to be made for this waste, but it seems proper to mention the fact that the engine worked under this slight disadvantage.

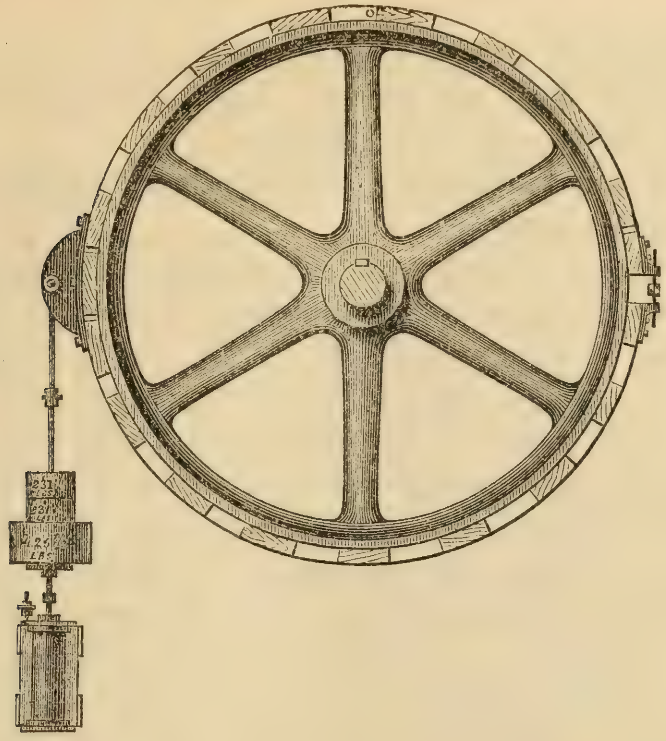
Every indicator diagram is given as numbered by me at the time. They were taken at irregular intervals, and the load on the engine was considerably greater during the latter part of the day than it was during the earlier part. Nevertheless, it is evident that they represent accurately, certainly not excessively, the quantity of work done; for the average of the first nine pairs of diagrams will be found to fall short of the general average a trifle more than that of the second nine exceeds it.

An important feature of this trial was the employment of steam slightly superheated. The mean temperature of the steam in the chest was 24.14 degrees greater than that due to the pressure, and this chamber, extending the entire length of the cylinder and around more than one-fourth of its circumference, acted also as a steam jacket, and one in which no condensation could take place.

It is interesting and highly instructive to note, in the tables, how, as the degree of superheating was raised, and at the same time a greater weight of steam was admitted to the cylinder, the per centage of the water accounted for by the indicator increased, and the economy, shown by the time required to empty the tank, was improved.

SECOND TRIAL.

For the purpose of this trial a friction brake was fitted to the band wheel of the engine, which was very suitable for this use, being nine feet in diameter by twenty-six inches width of face. The construction of this apparatus is shown in the accompanying drawing. Water was used as a lubricant, and care was taken to insure its uniform distribution over the face of the wheel, by discharging it from the pipe in numerous jets, and by cutting several diagonal intersecting grooves in each of the blocks. A small Allen engine cylinder, five inches in diameter, was employed to serve as a controlling vessel. This was filled with oil, the piston was accurately fitted, and communication between its opposite sides was made through the steam chest. This arrangement enabled the passage for the oil to be graduated, by means of one of the equilibrium valves, so that as much freedom of motion might be permitted to the weight sustained as was consistent with a reasonable degree of steadiness. It was found that the considerable quantity of water used on the face of the wheel, and its uniform distribution, rendered the action of the brake nearly free from those irregularities which often cause this instrument to give unsatisfactory results, and that a small amount of resistance in the controlling vessel enabled the attendant to maintain the point of suspension in its proper position, horizontal with the center of the shaft.



The point of suspension was designed to be at five feet and three inches from the center of the shaft, when the weight sustained would be lifted through thirty-three feet at each revolution of the engine;

but an error of the workman, in fixing the position of the controlling vessel, made it only five feet two and three-quarter inches from the center, and the weight to be lifted, at each revolution, through only 32.856 feet.

Each one pound sustained at the brake represented 4,107 foot pounds of work done per minute. Each 8.035 pounds sustained required the exertion of one horse-power.

Each 30.6 pounds sustained counterbalaced one pound of mean pressure in the cylinder.

For the purpose of making the experiments more satisfactory, and of a character to expose their own errors, or verify their own accuracy, five different weights were lifted, of 143 pounds, 374 pounds, 600 pounds, 800.5 pounds, and 1031.5 pounds, respectively. The first consisted of that portion of the weight of the apparatus itself which preponderated on the rising side, and which was carefully ascertained.

The weight of the apparatus itself requiring to be lifted was made up as follows: Piston, fourteen and a half pounds; rod, collar and nut, nine and a quarter pounds; second rod, washers, pin and cottar, 32¼ lbs.=56 pounds. The bracket weighed 113 pounds, and the tightening brackets on the opposite side weighed, with the screw, thirty-four and a half pounds—difference seventy-eight and a half pounds. This had its center of gravity, however, nearer to the center of rotation, and was equal to only seventy-four pounds at the point of suspension. There was, also, a preponderance of wood blocks equal to thirteen pounds at the point of suspension. (56+74+13=143 lbs.)

A number of diagrams were taken on each of the five trials, and the pencil was allowed to pass over each diagram from twenty to thirty times.

The trials on the 18th were only partial, and must be regarded as preliminary. It was found that the weights had been suspended in a manner to cause the piston to work hard in the controlling vessel. This was remedied before the trials of the next day, when the action of the brake was improved, and the several diagrams taken on each trial were more nearly alike. The diagrams taken on the 19th, as numbered at the time, are all given in the Table No. 4.

The diagrams were taken equally from each end of the cylinder, except one on the 5th trial. Those from the opposite ends were nearly, but not precisely, equal, which accounts for the more extreme differences appearing in the tables.

On each trial the diagrams from the same end ran nearly identica., although the relation between the pressures exerted on the opposite sides of the piston varied somewhat at different points of cut-off.

The diagrams do not show an equal proportional loss from friction, but are given as they are. By comparing the diagrams on the 1st and 5th trials, the increase of friction caused by the load is seen to be 3.5 per cent. That is, the difference between the diagrams exceeds, by this per centage, the difference between the weights sustained.

At the conclusion of the trial the band was removed from the wheel, and the engine was run for the purpose of obtaining the frictional diagrams, with the result given in the tables.

Steam was supplied on this trial, as on the first one, by the Allen boiler, having 900 square feet of heating surface, of which 730 feet were below the water line, and 170 feet were above it. Steam was easily kept up, while the engine was exerting 141.68 horse-powers.

To test the power of the engine, the steam pressure was run down below sixty pounds, and diagrams Nos. 21, 22 and 23 were taken, with an initial pressure of from fifty-three to fifty-six pounds, cutting off at .45 of the stroke, and developing 141.68 indicated horse-powers. The pressure was then raised to ninety pounds, and diagrams Nos. 24, 25, 26, and 27 were taken with an initial pressure of eighty-five pounds, cutting off at .23 of the stroke, and developing the same power.

Table No. 1.—The Water Evaporated.

Number of tanks.	Time at which the tank was filled.	Time required to empty the tank.	Weight of water required to fill tank.	Weight of water which the diagrams account for.	Per centage of the water accounted for.
	H. M.	Minutes.	Lbs.	Lbs.	Per cent.
1..............	11 00	47	1,562.5	1,226.6	78.50
2..............	11 47	48	1,562.5	1,258.0	80.55
3..............	12 35	52	1,562.5	1,363.6	80.90
4..............	1 27	57	1,562.5	1,494.6	95.65
5..............	2 24	56	1,562.5	1,468.5	94.00
6..............	3 20	56	1,562.5	1,468.5	94.00
7..............	4 16	44	1,562.5	1,431.6 *	91.58
8..............	5 00	65	1,562.5	1,431.6 *	91.58
9..............	6 05	55	1,562.5	1,442.7	92.33
10..............	7 00	58	1,562.5	1,520.0	97.28
11..............	7 58	57	1,562.5	1,494.5	95.65
12..............	8 55	65	1,562.5	1,704.5	109.09
			18,750.	17,304.7	

The twelfth tank was emptied a few minutes before ten o'clock, but the water was then too high in the boiler, and when—at ten o'clock—the engine was stopped, it had been reduced to the precise mark at which it stood at the start. About one-seventh of the water accounted for by the indicator during the last sixty-five minutes was derived from preceding tanks.

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* These two tanks are averaged.

TABLE NO. 2.

Duration of experiment (hours)	11.
Number of tanks of water evaporated	12.
Capacity of tank, in cubic feet	25.
Weight of one cubic foot of water (pounds)	62.5
Pounds of water evaporated	18,750.
Pounds of water evaporated per hour	1,704.5
Pounds of coal burned per hour	189.4
Mean pressure in the cylinder, above that required to neutralize the counter pressure (pounds on the square inch)	17.345
Horse-powers exerted for each one pound of mean pressure	3.808
Effective indicated power (horse-powers)	66.05
Coal burned per hour for each effective indicated horse-power (pounds)	2.868
Pressure of the atmosphere, in pounds on the square inch (assumed)	14.8
Mean back pressure above that of the atmosphere in pounds on the square inch (see note 2)	.983
Total mean pressure in cylinder, in pounds on the square inch	33.128
Total work done by steam in cylinder (horse-powers)	126.15
Coal burned per hour for each gross horse-power (pounds),	1.5
Proportion of work done by the steam that is reckoned as affective	.5236

TRIAL OF THE ALLEN ENGINE TO ASCERTAIN THE COST OF ITS INDICATED POWER.

TABLE No. 3—A—*Diagrams from Forward End of Cylinder.*

Number of diagram.	Time when taken.		Pressure in the steam , pipe by gauge.	Temperature of steam in chest.	Degrees of super-heat.	Initial pressure.	Proportion of stroke at which the steam was cut off.	Mean pressure.	Terminal pressure.	Theoretical terminal pressure.	Excess of terminal pressure above theoretical.	Average back pressure above atmosphere (independent of cushion).
	H.	M.	Lbs.	Deg.	Deg.	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1..	11	15	75.0	324.0	3.8	69.0	.09	16.30	—0.5	—3.7	3.2	1.00
2..	11	27	73.0	328.0	9.4	68.0	.10	17.40	—0.5	—3.6	3.1	1.00
3..	11	36	75.5	333.5	13.0	70.0	.12	17.35	—0.5	—2.0	1.5	1.00
4..	12	00	72.0	338.0	20.0	67.0	.10	15.50	—1.3	—3.3	2.0	1.20
5..	12	30	77.0	348.0	26.0	72.0	.10	14.80	—1.5	—3.2	1.7	1.20
6..	1	15	76.0	348.0	27.0	72.0	.11	17.55	—1.0	—2.3	1.3	1.08
7..	2	10	76.0	357.0	36.0	73.0	.09	15.30	—1.5	—3.5	2.0	1.00
8..	3	05	76.0	352.0	31.0	72.0	.10	16.90	—1.0	—2.7	1.7	0.75
9..	3	20	69.0	353.0	38.0	66.0	.12	18.95	—0.5	—1.6	1.1	0.50
10..	4	15	75.0	354.0	34.0	72.0	.11	18.70	—0.5	—1.8	1.3	1.00
11..	5	00	77.0	345.0	23.0	71.0	.12	18.65	—1.0	—1.3	0.3	1.00
12..	7	00	74.0	344.0	25.0	69.0	.13	19.75	0.0	—0.9	0.9	1.00
13..	7	30	70.0	342.0	26.0	68.0	.14	22.90	+1.0	+0.9	0.1	1.00
14..	7	45	74.0	344.0	25.0	70.0	.13	20.35	0.0	0.0	0.0	0.80
15..	8	50	74.0	347.0	28.0	70.0	.11	19.30	—0.5	—1.7	1.2	0.80
16..	9	03	74.0	344.0	25.0	71.0	.12	19.55	—0.5	—0.6	0.1	0.80
17..	9	20	58.0	not	......	57.0	.20	20.35	+1.3	+1.3	0.0	1.00
18..	9	35	63.0	taken	......	62.0	.18	20.90	+1.5	+1.5	0.0	1.00
Average			72.7	343.8	24.4	68.83	.12	18.36	—0.4	—1.6	1.2	.936
			73.25	344.0	23.88	71.1	.1	16.33	—0.51	—2.57	2.06	1.03
(2)			145.95	687.8	48.28	139.93	.22	34.69	—0.91	—4.17	3.26	1.966
Gen'l ave'ge			72.975	343.9	24.14	69.965	.11	17.345	—0.455	—2.085	1.63	.983

TABLE No. 3—B—*Diagrams from Back End of Cylinder.*

Number of diagram.	Time when taken.		Pressure in the steam pipe by gauge.	Temperature of steam in the chest.	Degrees of super-heat.	Initial pressure.	Proportion of stroke at which the steam was cut off.	Mean pressure.	Terminal pressure.	Theoretical terminal pressure.	Excess of terminal pressure above theoretical.	Average back pressure above atmosphere (independent of cushion).
	H.	M.	Lbs.	Deg.	Deg.	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1..	11	15	75.0	324.0	3.8	70.0	.100	15.07	0.00	—3.05	3.05	1.25
2..	11	28	74.0	328.5	9.1	71.0	.075	13.09	—1.00	—4.05	3.05	1.25
3..	11	34	75.5	332.0	11.5	72.0	.065	13.07	—1.00	—5.00	4.00	1.25
4..	12	03	74.0	337.0	17.5	71.0	.090	14.00	—1.25	—3.09	2.65	1.00
5..	12	27	77.0	348.0	26.0	73.0	.070	11.85	—2.05	—4.05	2.00	1.03
6..	1	11	76.0	348.0	27.0	75.0	.090	15.09	—2.00	—2.05	0.05	1.00
7..	2	12	76.0	358.0	37.0	73.0	.070	16.00	—1.00	—4.01	3.01	1.00
8..	3	05	76.0	352.0	31.0	75.0	.080	16.02	0.00	—3.00	3.00	1.00
9..	3	20	72.0	350.0	32.0	71.0	.090	17.02	—0.05	—3.00	2.05	1.00
10..	4	18	76.0	354.0	33.0	74.5	.100	17.06	0.00	—1.06	1.06	1.02
11..	4	55	79.0	347.0	23.0	76.0	090	17.05	0.00	—3.00	3.00	0.08
12..	7	00	74.0	345.0	26.0	73.0	.100	17.35	0.00	—2.00	2.00	1.00
13..	7	30	69.0	342.0	27.0	67.0	.150	19.00	+0.08	+0.07	0.01	0.09
14..	7	45	75.0	343.0	23.0	74.0	.100	17.15	—0.75	—2.05	1.75	1.00
15..	8	55	74.0	347.0	27.5	72.0	.100	17.65	—1.00	—2.65	1.65	1.00
16..	9	00	74.0	347.0	27.5	72.0	.100	17 45	—0.05	—2.00	1.05	1.00
17..	9	20	59.0	not	... ..	58.0	.170	17.15	0.00	0.00	0.00	0.08
18..	9	35	63.0	taken	......	62 0	.160	19.05	+1.05	+0.75	0.75	0.08
Average			73.25	344.0	23.88	71.1	.100	16.33	—0.51	—2.57	2.06	1.03

TRIAL TO ASCERTAIN THE PER CENTAGE OF THE INDICATED POWER THAT WAS USEFULLY EXERTED.

TABLE NO. 4—A—*Work done at the Brake.*

	First trial.	Second trial.	Third trial.	Fourth trial.	Fifth trial.
Weight sustained....................	143 lbs.	374 lbs.	605 lbs.	800.5 lbs.	1,031.5 lbs.
Foot pounds of work done per minute..............................	587,301	1,536,018	2,484,735	3,287,653	4,236,370
Horse-powers developed.............	17.797	46.546	75.295	99.624	128.375
Pounds of mean pressure in cylinder required to be in equilibrium.......	4.673	12.222	19.771	26.16	33.71

TABLE NO. 4—B—*Power Exerted in the Cylinder.*

	No. of diagram.	Pounds of mean pressure.	No. of diagram.	Pounds of mean pressure.	No. of diagram.	Pounds of mean pressure.	No. of diagram.	Pounds of mean pressure.	No. of diagram.	Pounds of mean pressure.
The mean back pressure above the atmosphere averages, on all these diagrams, .5 lb.	1	7.200	5	14.97	11	22.50	17	28.55	21	38.00
	2	7.275	6	14.55	12	21.55	18	27.95	22	37.45
	3	6.925	7	14.45	13	21.40	19	28.85	23	36.00
	4	7.150	8	14.50	14	32.10	20	28.85	24	37.00
			9	15.50	15	21.50			25	37.30
			10	14.60	16	22.75			26	37.50
									27	37.20
General average.........	....	7.14	....	14.76	....	21.97	....	28.55	....	37.207

Horse powers exerted...	27.19	56.2	83.66	108.72	141.68
Per centage of useful effect..................	65.45	82.8	90.	91.62	90.6

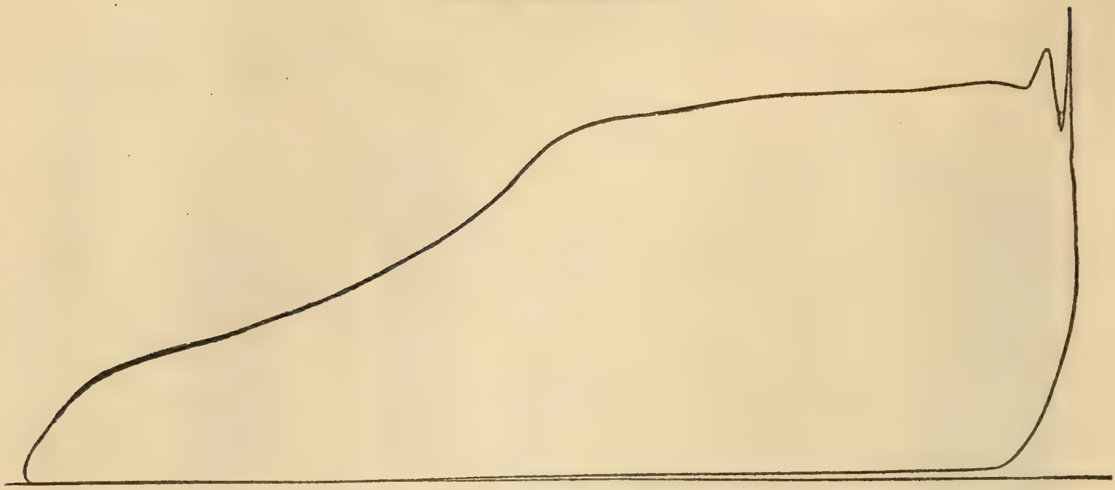
	Forward end of cylinder.		Back end of cylinder.		Average.
Frictional diagrams	No. 1.	No. 2.	No. 3.	No. 4.	
Mean pressure	2.225 lbs.	2.2 lbs.	.2.175 lbs.	2.1 lbs.	2.175 lbs.

TABLE No. 5—*Comparison of the results with those obtained last year.*[*]

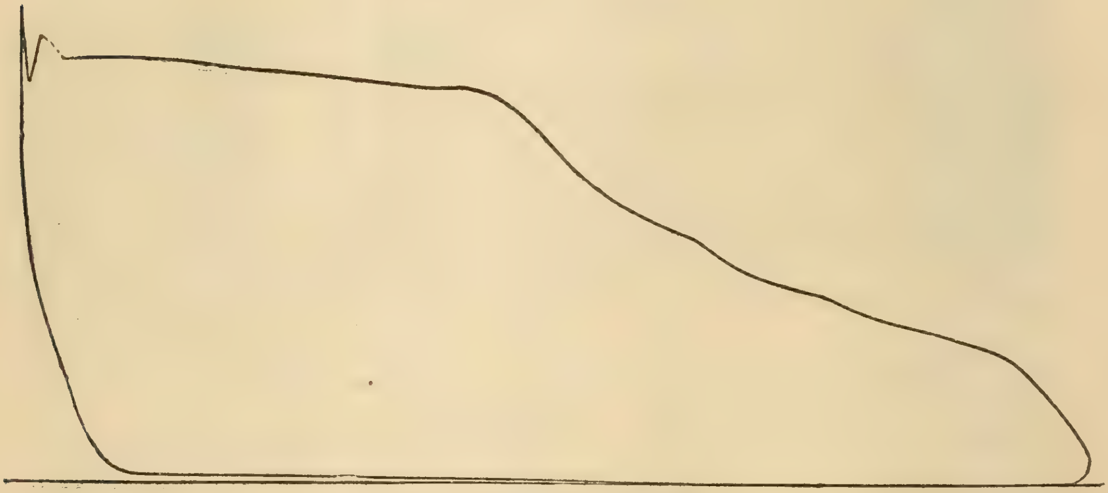
	Allen. 1870.	Corliss. 1869.	Babcock and Wilcox. 1869.
Diameter of cylinder (inches)	16.0000	16.1300	16.0000
Area of cylinder (square inches)	201.0600	204.2500	201.0600
Length of stroke (inches)	30.0000	42.0000	42.0000
Waste room adds to stroke (inches)	1.2300	1.3000	.6300
Revolutions per minute	125.0000	60.3440	60.2730
Feet traveled by piston per minute	625.0000	422.4000	421.9000
Cubic feet displaced by piston per hour	52,344.0000	37,014 0000	35,900.0000
Pressure of steam in pipe (lbs.)	72.9750	80.5100	81.6900
Initial pressure in cylinder (lbs.)	69.9650	70.9430	76.1480
Proportion of stroke at which steam is cut off	.1100	.2260	.1890
Effective mean pressure (lbs.)	17.3450	29.7280	31.0570
Effective horse-powers exerted	66.0500	76.5790	78.7920
Counter pressure above atmosphere (lbs.) see note 2	.5000	.6800	.8000
Pressure of the atmosphere (lbs.)	14.8 (ass'd)	14.8000	15.0430
Total mean pressure (lbs.)	33.1280	45.2080	46.9000
Gross horse-powers exerted	126.1500	116.4560	18.9850
Proportion of total work done by steam in cylinder, that is reckoned as effective	.5236	.6622	.6575
Pressure at termination of stroke, relatively to that of the atmosphere (lbs.)	—.4550	+5.1780	+3.0550
Total pressure at termination of stroke (lbs.)	14.3450	20.0000	18.1000
Weight of one cubic foot of saturated steam, at the terminal pressure (lbs.)	.0358	.0487	.0447
Pounds of water evaporated per hour	1,704.5000	1,995.5470	2,007.7460
Pounds of steam per hour, by indicator	1,573.8700	1,815.7230	1,595.4960
Per centage of water accounted for by the indicator	92.3600	90.9900	79.4700
Number of times the volume of steam is multiplied by expansion	6.0000	4.3000	5.0000
Ratio of gain by expansion	2.3000	2.2500	2.6000
Pounds of coal per hour for each effective horse-power	2.8680	2.8950	2.8310
Pounds of coal per hour for each gross horse-power	1.5000	1.9000	1.8700
Per centage of indicated power that was usefully exerted	91.1100	90.2300	87.2000

DIAGRAMS 21 AND 23.—TABLE NO. 4.

Scale 32 lbs. to the inch.



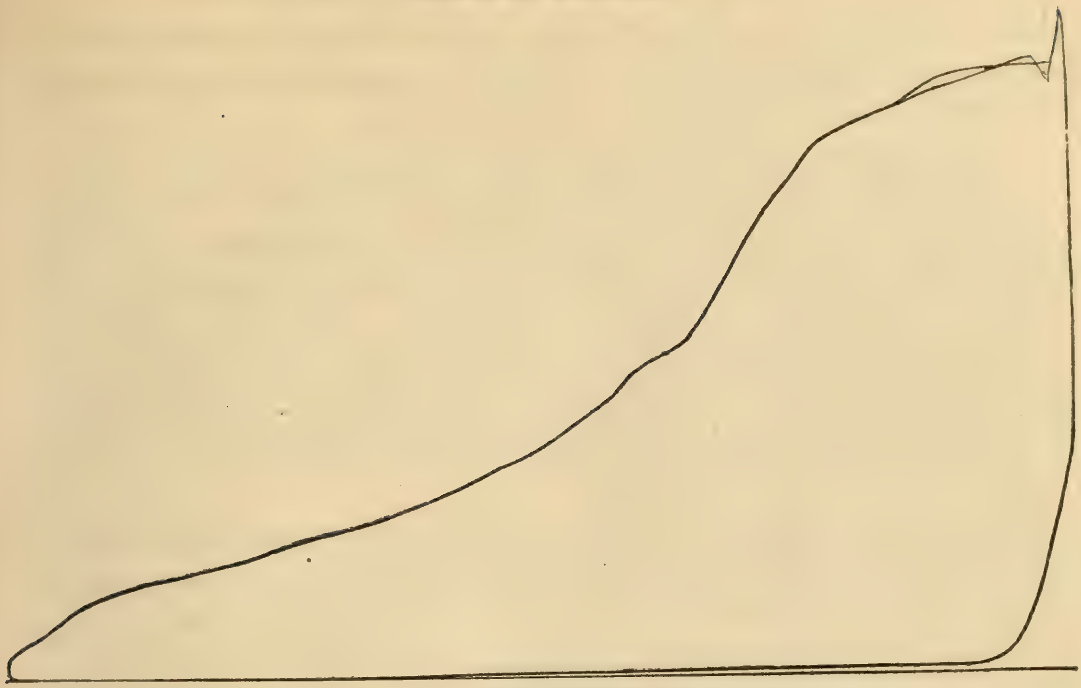
MEAN PRESSURE 36 LBS.



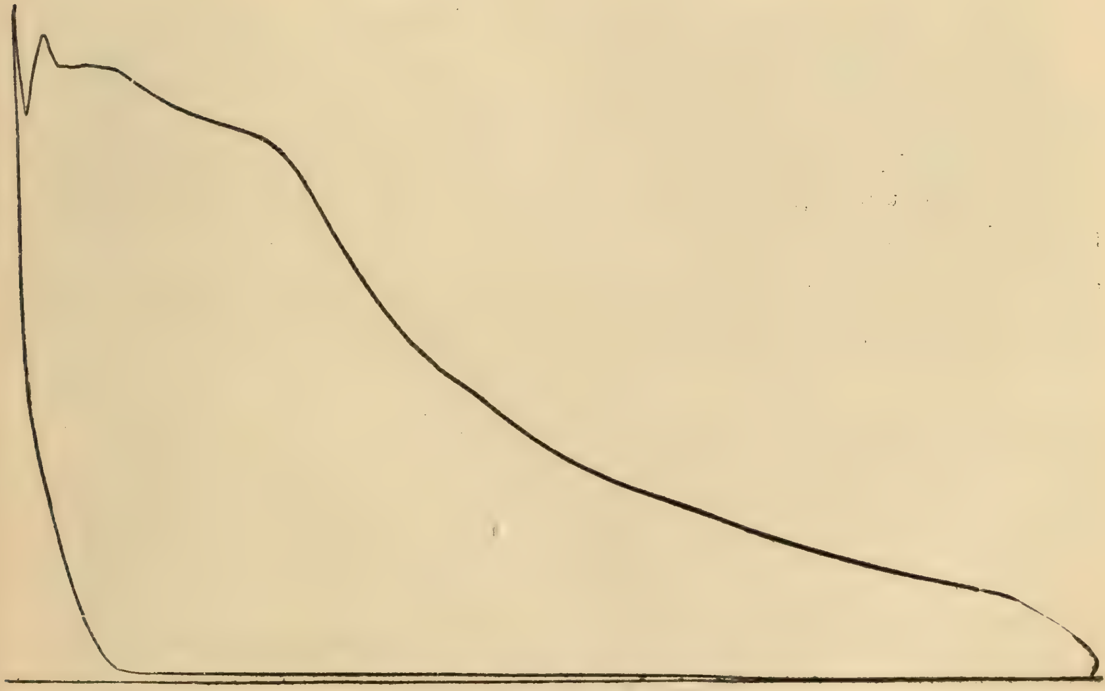
MEAN PRESSURE 38 LBS.

Diagrams 24 and 26.—Table No. 4.

Scale 32 lbs. to the inch.



MEAN PRESSURE 37 LBS.



MEAN PRESSURE 37.5 LBS.

NOTES ON THE FOREGOING TABLES.

1. *The Theoretical Terminal Pressure; how Obtained.*

The theoretical terminal pressure was ascertained by calculation from a point on the expansion curve after it was certain that the steam had been cut off—a method that insures accuracy.

2. *The Back Pressure less when more Steam was used.*

During the friction brake experiments, when the steam was discharged under some pressure, the back pressure was observed to be much less than during the trials for economy. This was doubtless owing to the fact that in the former case the large body of steam in the exhaust pipe was put in motion at high velocity by the pressure at the instant of release, while in the latter it was inert, and so resisted the motion of the piston.

The difference was very marked, and when the steam was released at from three pounds to six pounds pressure, the back pressure could not be judged to exceed .5 of a pound. In comparing the results with those of last year, when the steam *was* released at about this pressure, the latter decimal must therefore be used.

3. *The Total Pressure the only Correct Basis of Comparison.*

The Allen Engine Works had requested that the engine should be loaded for the trial to the extent of at least 100 horse-powers, in order that the mean effective pressure in the cylinder should be as great, or nearly so, as it was in the engines tried last year. Efforts were made to provide this amount of resistance, but with very poor success. The diagrams show only 66.05 horse-powers exerted, requiring a mean effective pressure of only 17.345 pounds against 29.728 pounds in the Corliss, and 31.057 pounds in the Babcock & Wilcox engine. No just comparison for economy can, therefore, be made, except by measuring the total work done by the steam in the cylinder in each case; for, if the work done in overcoming the atmospheric resistance were deducted alike in all the engines, then we would have only 52.36 per cent of the total work done allowed to the Allen engine, and an average of sixty-six per cent allowed to its competitors, as effective power, while in truth, the work of the steam in overcoming the pressure of the atmosphere is precisely the same as if the resistance overcome was that of a pump or a saw-mill. To illustrate this by a more extreme case, let the mean effective pressure be only five pounds, making, with the atmosphere, a total pressure of twenty pounds, and let the coal burned be, as in this case, 1.5 pounds per hour for each gross horse-power. Now, if the atmosphere is deducted, the consumption for each effective horse-power will be six pounds per hour.

It is obvious that when the pressures differ so widely as in the present case, a comparison made after deducting the atmosphere would give a very erroneous result.

The coal burned for the Allen engine, divided by 52.36 per cent of the power exerted by the steam, gives a quotient that is just the mean of those obtained by dividing the coal burned for the Corliss and the Babcock & Wilcox engines, by sixty-six per cent of the power exerted in them; and the coal burned in each case, divided by the total power exerted, shows a consumption, for the Allen engine of 1.5 pounds per horse-power per hour, against a consumption of 1.87 pounds for the Babcock & Wilcox engine, and of 1.9 pounds for the Corliss engine.

This economy is believed to be without precedent, except in cases where steam has been expanded in two or more cylinders, and reheated on the passage.

4. *The Ratio of Gain by Expansion shown by the Diagrams, of* 2.3, *theoretically correct.*

The ratio of gain by expansion is ascertained by dividing the mean pressure through the stroke, which represents the work done, by the pressure at the termination of the stroke, which represents the steam consumed in doing it. It will be observed that in the Allen engine this ratio is only 2.3, although the steam is cut off at .11 of the stroke, for which point of cut-off the theoretical ratio of gain is 3.2, and although last year the ratio of gain in the Corliss engine, cutting off at .226 of the stroke, was 2.25, and in the Babcock & Wilcox engine, cutting off at .189 of the stroke, it was 2.6.

The gain of 2.3 by expansion shown in the Allen engine is, however, perfectly correct, and consistent with the theoretical tables, as will appear, because, first, these tables make no account of waste room, and second, the terminal pressure, or divisor, is, on the diagrams, higher than the theoretical expansion calls for. In order to find both the point of cut-off, and the mean pressure, for any comparison of the diagram with the requirements of theory, the waste room must be regarded as forming a part of the piston displacement. In this case the steam followed the piston 3.3 inches. To this add the waste room, 1.23 inches, and we have the steam cut-off at 4.53 inches of the length of the stroke. The release commenced at 2.5 inches before the termination of the stroke, so that the expansion extended through

24.2 inches and the steam was expanded to 6.3 times only, instead of nine times its original volume.

But the ratio of gain for this expansion is 2.84. For the purpose of this computation, however, the pressure in the waste room must be added to that shown on the diagram, to obtain the mean pressure ($85 \times .0411 = 3.49$ pounds, and $33.128 + 3.49 = 36.618$ pounds). This, divided by the theoretical terminal pressure, 12.8 pounds gives the above ratio of gain precisely, while the mean pressure really exerted, divided by the actual terminal pressure, gives the ratio of 2.3, as shown in the table.

It cannot be contended that the superior economy of the Allen engine is due to its working more expansively, as its gain from expansion was not materially different from that of the other engines.

5. *The quantity of heat converted into work at each stroke of the piston.*

At each stroke of the piston 16,651.8 foot pounds of work were done in the cylinder, involving a loss of 21.57 units of heat, or heat sufficient to raise the temperature of one pound of water 21.57 degrees. The weight of steam which entered the cylinder was .1136 of a pound, and it contained 138.8 units of heat. Of the 21.57 units of heat lost during the stroke, 9.38 units were lost before the closing of the port, and might have been restored directly from the boiler. The remainder, 12.19 units, were converted into work during the expansion. Of this amount 2.78 units were supplied from heat set free by the expansion, leaving 9.41 units, which, if no other source of heat existed, must have been supplied by the condensation of nearly one-thirteenth part of the steam. But about one-half of the cylinder walls had a temperature equal to that of the steam in the chest, or 132 degrees greater than that of the steam when expanded to the atmospheric pressure, and this surface was sufficient, at the rapid reciprocation employed, to impart to the steam, during its expansion, a very considerable amount of heat, and in this manner, without doubt, the heat converted into work was so far restored to the steam as to cause the indicator to account for the very large per centage of the water evaporated that is shown in table 1.

6. *Comparison of power given off.*

In stating the power given off by the Allen engine, in comparison with that given off by the Corliss, and the Babcock & Wilcox engines, it is necessary to have regard to the mean pressures exerted.

The mean effective pressure exerted in the latter engines averaged about thirty pounds on the square inch of piston.

During one of the experiments with the friction brake, the mean effective pressure in the Allen engine was 28.55 pounds, and during another it was 37.207 pounds. It seems fair to take the mean of these two as the comparative duty of this engine, which is thus fixed at 91.11 per cent of the indicated power.

Conclusion.

The performance of the Allen engine, it will be seen, exceeded that of the engines tried last year, both in its economy and in the proportion of its indicated power that was given off in useful effect, and also what its high speed renders especially remarkable, in the proportion of the steam pressure in the pipe that was realized in the cylinder, and in the absence of back pressure. It ran also through the fair, and on many of the days for eleven and twelve hours continuously, without ever having a warm bearing.

Under the resistance of 128.375 horse-powers at the brake, the motion of the engine was remarkably uniform; not the least diminution of speed in passing the centers could be detected, illustrating very satisfactorily the value, in this respect, of the speed employed, and of the action of the reciprocating parts of the engine in equalizing the rotative pressure on the crank through the stroke. The governor was, during the trials and through the exhibition, nearly motionless while the load remained constant, and instantaneous in its action on changes of resistance, maintaining a steadiness of running which left nothing to be desired.

Respectfully submitted.

WELLINGTON LEE, C. E.

REPORT OF THE JUDGES IN DEPARTMENT V.—Group 2.

No. 691. *Steam Pump for Feeding Boilers.*—Valley Machine Co., Easthampton, Mass.

This is an extremely simple and compact vertical steam pump, provided with a crank and fly-wheel. The pump is of the combined piston and plunger variety, and has but two valves, though possessing the same advantages as respects a steady delivery as the ordinary double-acting pump. No large sizes were exhibited. Rated for best crank-feed pumps, first in the order of merit.

No. 1103. *Steam Pumps.*—Woodward Steam Pump Manufacturing Company, 76 to 80 Center street, New York.

The crank pumps manufactured by this establishment have been long and favorably known. In their duplex pump two of the excellent crank pumps are arranged on the same bed plate and connect to cranks at right angles on a common shaft. The combination insures a steady delivery of water, at any desired speed, with the further advantage, incident to any duplication, that one of the elements may be used independently in case of accident to the other. Rated for best duplex steam pump, first in the order of merit.

No. 949. *Direct-acting Steam Pumps.*—Charles B. Hardick, Brooklyn, N. Y.

At the American Institute exhibition of 1867 this pump was carefully tested by the judges, in competition with several other pumps, and was awarded the first premium. At this exhibition only two different direct acting pumps were exhibited, viz.: the "Niagara," and another which was entered "for exhibition only." The representatives of the pump last mentioned were requested by the judges to permit their pump to be again tested; but they positively refused, and no competitive trial could be had. We consider that the judges, in all practicable cases, should be assisted in making their awards by actual tests of the articles in competition, and it would be manifestly unjust for us to materially modify the decision of a former board of judges when the same was based upon actual trial, except for extraordinary reasons. No such reasons exist. On the contrary, we find that the Niagara pumps exhibited at this time are first class in every respect, and operate to our entire satisfaction. The pump has also been improved during the past year by constructing the valves of vulcanized India rubber with a metal core, the shape of the valves and the excellent arrangement for examining the same being retained. In view, therefore, of the above considerations, we award this pump the position of first in the order of merit.

TRIAL OF THE CENTRIFUGAL PUMPS.

To enable the judges to ascertain the relative merits of the centrifugal pumps, they requested that arrangements be made for testing the same. The managers so ordered, but it was so late in the exhibition before the necessary apparatus could be constructed and arranged that but one pump was tested, viz., a centrifugal pump, manufactured by William D. Andrews & Bro., of New York. The pump tested had a discharge orifice of six inches diameter; the water was received from the side of a large tank, and was delivered under a head varying, for the different experiments, from 19½ to 19¾ feet; the lower part of the discharge pipe was six inches in diameter, but it rapidly expanded to twelve inches diameter, which size was continued up to a tank about three feet square, over one side of which the water flowed into a chute, suspended so that the current could be quickly directed either into a measuring tank or directly back to the receiving tank. The pump was driven by a steam engine, through a countershaft carrying one of Neer's dynamometers.

The results of the trials are shown in the following table:

Number of experiment.	Duration of experiment. Seconds.	Revolutions of pump per minute.	Gallons of water delivered per minute.	Average head.	Dynamometer horse-power.	Net horse-power.	Per centage utilized.	Per centage utilized allowing for friction caused by driving belts.
1	30	552	1,204	19.55	9.752	5.949	61.00	65.18
2	30	526	1,105	19.55	8.323	5.463	65.64	70.71
3	40	489	863	19.47	5.689	4.247	74.64	82.76
4	40	552	1,293	19.75	10.000	6.454	64.54	68.84
5	40	529	1,279	19.75	9.117	6.385	70.02	74.93
6	40	497	951	19.50	7.163	4.687	65.44	70.96

The tests were made subject to the disadvantages which are apt to attend the use of temporary apparatus. The tanks leaked a little and wet the belts, requiring the latter to be made very tight. Still the results obtained undoubtedly approximated to accuracy, and certainly were in no degree in favor of the pump. The net horse-powers shown in the table were calculated from the weights of the water and the heights lifted. The column preceding the last shows the per centages utilized when the friction caused by the driving belt is *not* considered. It will be seen that the results of the different experiments are in keeping with each other, as well as could be expected for such short trials with temporary apparatus. The last column shows the per centages utilized when an allowance is made for the friction caused by the driving belt, but with no allowance for the friction of water in the pipes.

Clarke's report of the trial of centrifugal pumps, at the London Exhibition of 1862, shows that an immense "Appold" pump lifted about 16,000 gallons of water six feet high per minute, utilizing 73.74 per cent of the indicated power of the engine, allowing ten per cent for the friction of the engine; the pump itself utilized nearly eighty-two per cent of the power applied to it. The "Gwynne" pump, tried at the same time, utilized, according to Clarke, 56.5 per cent of the indicated power applied, or as calculated by Colburn, in the interest of Gwynne, 83.13 per cent, allowing largely for friction of engine, and with an additional allowance for friction in a thirty-six inch discharge pipe.

Examining the results given by the Andrews pump, tested by us, it will be observed that most, and probably all, of the experiments were made at too high a speed to obtain the most economical results, for the average results given, with a delivery of *less* than 1,000 gallons per minute, are more than seven per cent larger than the average results attained, with a delivery *greater* than 1,000 gallons per minute; so that we are assured that the best result given, viz., 82.76 per cent, is not too high. Comparing this with the best result obtained abroad, we find that the small Andrews pump, with an economical capacity of 850 gallons per minute, for the lift of 19.5 feet, operated with slightly more ecomony than the Appold pump, which was of sufficient size to deliver 16,000 gallons per minute six feet high. This comparison shows, in the most decided manner, the great superiority of the Andrews pump. The difference in the friction of the water in pumps of such disproportionate size would, *for the same lift*, be comparatively enormous. But this great difference is augmented in favor of the Andrews pump by the higher speed and larger resistance necessary to raise the water against the greater head. So also the friction in the small pipes should be allowed in Andrew's favor, for the Appold pump, with its low lift, used tanks simply, and required no pipes. Most of the same considerations apply to Colburn's rather questionable estimate of the performance of the Gwynne pump for Andrew's pump, without allowing for friction in the pipes, raised about 850 gallons per minute, with substantially the same per centage of economy that Gwynne is said to have obtained, with an allowance for friction in pipes, when raising upward of 20,000 gallons per minute. Again, the Andrews pump, when being tested, delivered into a measuring tank. Hence no air was carried into the large receiving tank by a return current, and the weight of the column of water lifted was *not* diminished by air bubbles, as *was* the case in the English experiments. We conclude, therefore, that our experiments, taken in connection with those made abroad, show conclusively that the Andrews pump is greatly superior to any that has ever been tested.

The other centrifugal pumps exhibited were the Andrews central discharge pump, Gericke's turbinate pump and Starkey's centrifugal pump. In the two pumps first named, the rapid tangential motion of the water is changed into a slower movement parallel with the shaft and the *vis viva* of the moving mass utilized in urging forward the column, by means of curved stationary guides placed in an expanding annular discharge chamber. The judges have no means of deciding who was the first inventor of this important improvement. In the first named pump, however, the water is moved along easier curves, and undoubtedly, therefore, with less friction than in the other. In addition, the Andrews central discharge pump has the the same admirable arrangement for balancing the thrust of the wheel used in the other pump, by the same manufacturer, while the thrust of the wheel in the Gericke pump is carried entirely by collars.

The Starkey pump is of very simple mechanical construction, and is not designed to obtain unusual economy.

No. 821. *Centrifugal Pump.*—Wm. D. Andrews & Brother, No. 414 Water street, New York.

This is the best centrifugal pump with which we are acquainted. The scroll shaped discharge pipe keeps the water in motion in nearly the same tangential direction with which it leaves the wheel and the energy stored up in the mass of water, at its high velocity is utilized in urging forward the column. The efficient method of balancing the thrust of the wheel cannot be to highly commended. Upon a practical trial, this pump gave results which proved it greatly superior to any pump which has heretofore been tested in any part of the world. Award for best centrifugal pump: First, in the order of merit.

No. 820. *Central Discharge Centrifugal Pump.*—William D. Andrews & Bro., No. 414 Water street, New York.

This is the best central discharge centrifugal pump with which we are acquainted. The water is caused to move in easy bends, and is delivered by the wheel against curved deflecting plates in an expanding, annular discharge chamber, terminating in a central discharge opening. The method of balancing the thrust of the wheel is very simple and efficient. This pump is in our opinion only excelled by the other centrifugal pump manufactured by the same firm. For a centrifugal pump: Second, in the order of merit.

No. 71. *Turbinate Force Pump.*—J. H. A. Gericke, 169 Broadway, New York.

This is a simple and excellent centrifugal pump. The curved deflecting partitions in the discharge chamber are in our opinion efficient and valuable. For a centrifugal pump: Third, in the order of merit.

No. 768. *Centrifugal Pump* (Starkey's). Wm. Taylor & Sons, 25 to 39 Adams street, Brooklyn, N. Y.

The pump exhibited was of very simple mechanical construction. The openings in the wheel were large to give free passage to dirty water: Fourth in the order of merit.

REPORT OF THE TRIAL OF THE DEEP WELL PUMPS.

To assist the judges in ascertaining the relative merits of the hand pumps for deep wells, a trial was made of the same. There were in competition four different pumps designed for this purpose, three of which were tested, and will be distinguished in this report as the "American Submerged Pump," the "Forrester Submerged Pump," and the "Cowing Deep-well Pump."

The two pumps first named are double acting, and are placed in the water near the bottom of the well. In the American submerged pump the delivery pipe is connected at the bottom to the pump piston, and extends up through the platform, where, by means of a bell crank and link it is operated up and down by motion imparted to a vertical lever, the water being delivered through a "goose neck" secured to the upper end of the pipe. In the Forrester pump the delivery pipe is attached to the piston, and terminates at the top in a goose neck, the same as in the other pump; but the pipe and piston are held stationary, and the motion is imparted to the pump cylinder by means of a rod which runs in guide eyes secured to the pipe, which rod extends above the platform and is operated by a bell crank and vertical lever in the same way as the pipe of the other pump. The Cowing deep well pump is an ordinary metal lift pump, possessing no novelties in construction so far as we are aware. The pump cylinder is submerged and is connected with the stand above by a pipe through which runs the rod which operates the bucket. This rod passes through a stuffing-box at the top of the stand, and is operated by the well known pump-brake.

The pumps tested had very nearly the same capacity of cylinder; but as the Cowing pump was single-acting, it was practically of but half the size of either of the others.

During the trial the pumps were secured to a platform on the roof of the rink, and received water from tanks placed underneath on the floor of the building. The water was lifted in each case fifty-three feet. Two tests were made of each pump. One to ascertain the quantity of water delivered with a free discharge, which quantity was determined by actual measurement, and the other to ascertain the distance which each pump would throw water through the same hose nozzle. During the trials two of t alternated in operating the pumps, and endeavored to exert t power in each case. The rate of delivery for each pump, when briskly as could conveniently be kept up for forty seconds, wi discharg (averaging the performances shown by successive trials by the was as follows:

NAME OF PUMP.	Gallons delivered per minute.	Relative delivery.	
American Submerged Pump	14.57	1.29	1.23
Forrester Submerged Pump	11.86	1.05	1.00
Cowing Deep-well Pump	11.26	1.00	.95

Upon trial with the hose, using the same nozzle in each case, substantially the same difference in result was shown. The water was thrown on an adjoining roof a little lower than the pump platform. The representative of the American submerged pump was able to throw water in this way about ninety feet, or about fifteen feet farther, we judge, than the distance reached by water from the other pumps.

In the opinion of the judges, substantially the same power was required to operate the American and Forrester submerged pumps. The Cowing pump required less power than either of the others, but, as shown by the table, it delivered considerably less water in the same time than the American submerged pump; so the power required by each of these two pumps, was probably just in proportion to the work done. With a double-acting pump, a man can exert his full strength in both directions, while with a single-acting pump considerable time is occupied in lifting the handle for the return strokes, which movements do not require much power, but reduce the capacity of the pump as compared with that of a double-acting pump.

It is evident that, other things being equal, the capacity of a pump is the true measure of its value and usefulness, for, if the greater capacity be not needed ordinarily, it is at any time available in case of an emergency, as, for instance, for staying a conflagration; hence the test shows accurately the relative merits of the different pumps, unless mechanical objections overbalance the results, which is not the case.

In addition to the test the judges requested of the several pump manufacturers a list of the points of superiority which they claimed for their pumps. A perusal of these points suggested the following brief discussion:

ng valves for both ends of the American submerged pu the bottom of the stationary cylinder; hence, in dry we pump will draw the water considerably lower than the The op F pump, the valves of which are upon the upper and lower er: moving cylinder. The American submerged pump, erected ce, is also cheaper than any metal single-acting pump. The vanized iron stays for the pipe of the Forrester pump are highly approved; still, the use of the wooden support for the pipe of the American submerged pump does not constitute an important objection, for, when the pump has outlasted the wood, a new stick has certainly been earned. The stationary pipe in the Forrester and Cowing pumps makes it more convenient to carry off side branches than with the American submerged pump, but in the Forrester pump this advantage is more than counterbalanced by the fact that the operating rod takes hold at one side of the center of the moving pump cylinder, and thereby cause considerable friction against the sides of the guiding pipe, which must partially account for the comparatively low performance of this pump, for one acting in both directions.

In the American and Forrester submerged pumps, the water runs back out of the pipe as soon as the operation of the pump ceases. Upon trial it required five strokes to fill the pipe so as to deliver water with the American submerged pump, and twenty-five strokes with the Forrester pump. The Cowing deep-well pump required more strokes to fill its pipe, so as to deliver water the first time, than either of the others, but having a leather foot valve the water did not run back. The Cowing pump has also leather packing on the pump bucket, but the latter is well fitted to the cylinder and is of sufficient depth to ensure the operation of the pump when the packing is worn out.

The American submerged and Cowing pumps were very excellent examples of their respective classes, and operated with very little friction. The results shown are probably far in advance of what could be obtained with pumps from many other manufactories; for, in most instances, pumps with leather packing, in comparatively rough cylinders, require more power to overcome friction than to lift the water.

An examination of the points presented shows, however, that some of the pumps tested can be used for other purposes than those mentioned, either with or without some adapting attachments. For instance, the Cowing pump, from the small size of the pump cylinder and the fact that the working parts are entirely inclosed, is especially adapted for use in boxed wells of such small diameter that nothing larger than the pump barrel will enter, and is also adapted, by the attachment of the usual perforated point, for the so called "driven wells," which have attracted so much attention in many localities. Neither of the other pumps can be used at all in either the bored or driven wells, except imperfectly, as suction pumps, for depths of less than thirty feet. The Cowing pump is adapted for efficient use in any well of any depth, and is the best pump for the bored or driven wells with which we are familiar. We had deemed, therefore, to award this pump the position of first in the order of merit, for "An excellent pump for all wells, and the best pump for bored or driven wells;" but after further consideration, we do not recommend any award other than a certificate of our opinion, for the reason that the pump, as modified for bored and driven wells, is substantially the same as the one that was tested as a deep well pump, and the system of granting awards of equal value to more than one competitor in a test, even if such an award be based upon the different valuable and exclusive peculiarities and a different use of the article, is likely to be misunderstood by the uninvestigating public, and leads to discussions and uncharitable remarks. A test, if made at all, should be held to be decisive until another test can be made. But since, to avoid misapprehension, we decline to recommend an award to an excellent modified form of the Cowing pump, the best for a different purpose from that for which the pump was tested; so, also, we desire to make the rule uniform with the other competitors, and *withdraw* the recommendation, made in a preliminary report in regard to No. 176, for a submerged ship pump, which is but a modified form of the American submerged pump, and have modified the award for that pump to include its use on ships.

No. 179. *American Submerged Pump.*—Charles F. Mudge, No. 55 Chambers street, New York.

A simple, cheap and reliable double-acting submerged pump, adapted for use in wells or on ships. This pump gave the best results on a practical trial of any pump tested. For the best submerged pump: First, in the order of merit.

No. 577. *Double-acting Force Pump* (*Forrester Submerged*).—Forrester Manufacturing Company, Bridgeport, Conn.

A simple and efficient double-acting submerged pump, possessing superior facilities for securing the pipe in the well without the use of wood, and for making water connections below the pump platform. For a submerged pump: Second, in the order of merit.

No. 939. *Deep Well and Distance Pump.*—Thomas Hanson, No. 291 Pearl street, New York.

In this arrangement one pump operates by hydraulic pressure a combined hydraulic engine and pump. The latter forces water to any desired point by the application of power to the former, which may be located at any distance from or elevation above the other. There are situations where the device would be valuable, but the small per centage utilized of the power applied and the amount of mechanism necessary to accomplish the result will confine the application of this ingenious invention to special locations.

No. 574. *Water Elevator.*—C. W. Meyer, No. 86 Nassau street, New York.

In this invention a pipe bent in the shape of an involute receives, when revolved, alternate volumes of air and water, and raises the latter to the desired height with little loss of power. The nicety with which the water level must be adjusted renders this ingenious apparatus of limited application.

No. 107. *Steam Vacuum Pump.*—George H. Nye, Monmouth, Illinois.

This is an improved form of the old Savery pumping engine. The loss by condensation incident to any apparatus where the steam is used in the same vessel as the water is obviated, the inventor claims, by the interposition of a stratum of air between the steam and the water. We cannot too highly commend this ingenious device, for the reason that air is of greater density than steam of low pressure, and the two would, therefore, not mingle at once with each other. Still we have doubts whether this apparatus can successfully compete in economy with pumping engines. This point can only be settled by a test. The pump operates well, and for its cheapness and simplicity would be of undoubted value in many locations, whatever the result in respect to economy. Having had no opportunity to test this pump, we recommend that a certified copy of this opinion be furnished the exhibitor.

No. 1186. *Garden Engine.*—Cowing & Co., No. 78 Chambers street, New York.

This is a simple and efficient garden engine. It is easily operated by one man, and its superiority was proved to the judges by a practical trial with another engine in competition. First, in the order of merit.

No. 178. *Garden Engine.*—Charles F. Mudge, No. 55 Chambers street, New York.

Second, in the order of merit.

No. 177. *Fountain Pump.*—Charles F. Mudge, No. 55 Chambers street, New York.

In this arrangement an American submerged pump is used to force water into a barrel, thereby compressing the air and creating a pressure, which is utilized for supplying water to a fountain. The combination will be found useful in some cases.

The firm of Cowing & Co., of Seneca Falls (warerooms No. 78 Chambers street, New York), made a very complete and attractive display of pumps, designed for various locations and uses. We consider the pumps exhibited by this firm, without exception, first class in design, materials and workmanship. The pump barrels are all polished internally by patented machinery which reduces the friction materially, and increases the durability of the packings and of the barrels. Upon visiting the warerooms of the firm we found that the articles exhibited were fair samples of their stock.

We desire to award this firm for a complete and attractive display of pumps and other articles, and for superior workmanship: First, in the order of merit.

Each of the several articles exhibited by the said firm of Cowing & Co. is worthy of special mention, as evidently no exertions have been spared to produce the best articles of the kind in use. We would, in addition to those previously mentioned, call attention to the following articles of their manufacture, as worthy of especial notice.

No. 1181. *Railroad Force Pump.*—The method of securing the valves, and the arrangement of the same to render them accessible is worthy of especial commendation and award.

No. 1187. *Hot Water or Molasses Pump.*—The arrangement of the parts of this pump is the same as that of any ordinary lift-pump. It is, however, provided with composition linings, metallic plunger, and valves well secured and fitted, and appears to be the perfection of a lifting pump, and worthy an especial award.

No. 1172. *Hydraulic Ram.*—This device does not fall behind the other articles exhibited in workmanship, and possesses some novelties in the means used for adjusting the lift of the overflow valve, and for causing the same to revolve and thus wear its seat evenly. The judges observe in this ram the qualities of certainty and reliability so necessary in an article which is expected to work continuously and without attention, and recommend a special award.

No. 1170. *Railroad Tank Valve.*—This valve is designed to furnish means for rapidly appeasing the thirst of the iron horse at railroad stations, and to prevent at the same time the dripping from the pipe which injuries the road-bed, and often inconveniences the passengers on their way to the train. The design, gun metal fittings and good workmanship, accomplish the purpose in an effective and commendable manner worthy of an especial award.

No. 395. *Rock's Patent Ring Valve.*—G. S. Redfield, No. 15 Gold street, New York.

In this invention a split ring is substituted for the ordinary gate valve. The device reduces the labor of construction and appears to be of sufficient value to deserve more complete development.

No. 481. *Valve Refitting Machine.*—Charles F. Hall & Son, No. 65 Murray street, New York.

With this apparatus the seats of valves of all sizes may be trued up in place, and the valves fitted to them with the greatest facility and perfection. The device cannot be too highly commended. First, in the order of merit.

No. 1628. *Non-corrosive Joint.*—William Stamp, Susquehanna depot, Pa.

This is one of those excellent mechanical devices too often overlooked, but, in this case, possessing so much merit as to deserve especial attention and commendation.

No. 108. *Multiplying Pressure Fan Blowers.*—Patrick Clark, Rahway, New Jersey.

In this invention several fan-wheels are arranged upon the same shaft, and the air is successively discharged from the case of one into that of the next, its pressure being increased at each passage. The advantage is, that the speed of revolution and consequent noise and wear and tear are very much reduced. The invention is ingenious and, we think, quite useful. First, in order of merit.

No. 580. *Sturtevant Fan Blower.*—Charles Merrill & Sons, No. 556 Grand street, New York.

This fan blower is the perfection of design and workmanship, and is the best of which we have any knowledge. First, in the order of merit.

No. 588. *Root's Rotary Blower.*—S. S. Townsend, No. 31 Liberty street, New York.

This blower gives a positive blast of any desired intensity by the displacement of air with rotating pistons, requiring no valves. The apparatus, therefore, possesses the advantages of the old noisy and troublesome piston blower, with very nearly the simplicity of the common fan blower, which can be used only for much lower pressures, and the blast from which has no power to overcome resistance. First, in the order of merit.

No. 343. *Hose, Hose Pipe and Fire-buckets.*—E. Warren & E. E. Darrow, No. 35 Spruce street, New York.

These articles were, in our opinion, made in the best manner and of the best materials. First, in the order of merit.

No. 1237. *Rubber Suction and Fire Hose.*—New York Rubber Company, No. 5 and 7 Dey street, New York.

These hose possess many excellent features. The suction hose are smooth, both inside and out. The fire hose have reinforced ends, furnishing strength where it is most needed, and a rubber cap is placed over the cut end of the hose to prevent the water from saturating the layers of cloth. This hose stood a satisfactory test as to pressure. First, in the order of merit.

No. 1014. *Hooped Bellows.*—Newcomb Bros. & Sons, No. 586 Water street, New York.

A specimen of well made bellows, promising permanent usefulness.

No. 1057. *Ball's Improved Method of Tapping Cement-lined and Cased Pipes.*—Union Water Meter Company, Worcester, Mass.

This device supplies efficiently a want created by the introduction of cement-lined and cased pipe, and merits the highest commendation.

No. 236. *Hose Coupling.*—George Sewell, Brooklyn Navy Yard.

This hose coupling possesses, in our opinion, a decided advantage over any other in use, from the fact that both parts of the same are alike, the distinction of male and female being unnecessary, and, in fact, in no way applicable. In the use of other couplings it is sometimes necessary to change the ends of a long length of hose in order to bring the male and female portions together, at the critical moment when a little water, *applied promptly*, might stay the conflagration and save a large amount of property. With Mr. Sewell's coupling this can never occur, as either end of any length of hose may be coupled to either end of any other length. The connection can also be made with the greatest facility and security, and so as to be perfectly water tight. First, in the order of merit.

No. 540. *Hose Coupling.*—Barney Mee, Troy, N. Y.

The joint in this coupling is made by the pressure of the water inside a thin rubber ring. The coupling operated satisfactorily and may be connected and disconnected by hand instantly. Second, in the order of merit.

No. 118. *Hose Coupling.*—R. J. Gould, Newark, N. J. Third, in the order of merit.

Respectfully submitted.

CHARLES E. EMERY.
MASON R. PIERCE.
EDWARD S. MAGEE.

NEW YORK, *January 23d*, 1871.

REPORT OF THE JUDGES IN DEPARTMENT V.—GROUP 5.

The undersigned Judges in Department V, Group 5, after a full and careful examination of the several articles referred to them, respectfully submit the following as their report thereon.

No. 546. *Machine for Spreading Flax, Hemp, etc.*—John Good, Brooklyn, E. D., N. Y.

This machine performs its work in an eminently satisfactory manner. The fibrous material, say flax, is fed from the bale, in its tangled and knotty state, through a pair of feeding rollers, when it is caught by a series of teeth arranged upon an endless belt, which constitutes a carrier, by which it is carried along slowly to the disentangling and straightening mechanism, the latter consisting of a series of teeth arranged upon an endless belt, and in such a manner that they enter the flax in a vertical position and leave it in the same manner, hence their drawing or hetcheling action is always on a horizontal line, and, consequently, there is no tendency on the part of these teeth to detract or draw the flax from its horizontal line of travel. The series of carrying or feeding teeth, we are informed by the exhibitor, may be arranged upon drums or shafts, but that it is necessary that the disentangling teeth be so arranged as to enter the flax in a vertical position, else they would thow the flax upward and draw it down as they enter and leave the same. The distance between the feed rollers and the disentangling teeth is such that each strand of flax will have left the feed rollers before being caught by the disentangling teeth, and hence all liability of breaking the strands in this way is obviated. We had the pleasure of seeing flax taken from the ball in a very tangled and confused state passed through this machine, and delivered in a straight, disentangled continuous sliver or sheet, and in a most merchantable condition. Mr. Good exhibits a *good* machine, and we recommend that it be awarded a first premium.

No 32. *Fan Carpet Cleaning Machine.*—Alexander Stevenson New York city.

In this machine a feed and a take-up roller is employed at respective sides of the machine. The carpet passes from the feed roller over a roller covered with rope, which takes the place of the brush cylinder in other machines, from thence over a yielding bed, a spring bed, thence over another rope-covered roller to the take-up roller. The carpet is beaten by a beater in the hands of the operator whilst at rest upon the yielding bed. A fan, we are told, is employed to drive away the dust. The exhibitor claims, among other things, that the machine is "simple," "cheap," and "efficient," which claims we are disposed to allow. We deem the machine well worthy of honorable mention.

No. 764. *Wool Oiling Machine.*—T. A. Campbell, New York city.

This machine is quite an improvement upon the machine for a similar purpose exhibited by the same inventor at the last preceding exhibition of the American Institute. In this machine the oil is fed by compression plates instead of by a lifting roller. The revolving brush shaft carries an eccentric, which is connected by a strap and rod to a crank upon a rock shaft, which latter is connected by arms and links to a compression plate working upon or against an inclined plate. The operation of the mechanism is such that at one point of the revolution of the brush shaft the compression plate opens at its lower end, which is in the oil reservoir, and allows oil to run between it and the inclined plate; and at a further point during the revolution of said brush shaft, said lower end closes against said inclined plate, and the compression plate squeezes or forces the oil up the incline so that it flows over the edge of the inclined plate at which point the revolving brush strikes it and throws a fine spray upon the wool passing along under the brush. The oil which flows over the edge of the inclined plate is conducted back into the reservoir. The quantity of liquid elevated may be regulated by changing the distance of the compression plate from the inclined plate. A mixture of oil and water may be used successfully with this machine. The under side of the compression plate is preferably provided with an absorptive pad. The inventor submits to us the following points of excellence claimed for his machine: 1st. The utmost economy in distributing the oil or liquid on the wool in its passage to the carding machine, for the oil, being converted into minute particles of spray, allows a large area to be thus oiled or moistened evenly. 2d. The perfect mixing or mingling of the oil or mixture by flowing over and between the plates or compressors as also the uniform supply for the revolving brush. 3d. The utmost simplicity of its mechanism, and the arangement to prevent the dripping from the brush and plates. 4th. The arrangement to allow a greater or less quantity of oil or liquid to be used on the wool, and its ready adjustment therefor. We allow these several claims, and recommend that the exhibitor be awarded a first premium.

No. 987. *Flax Scutching Machine.*—Wm. C. McBride, Somerville, N. J.

This is a crude appearing machine, but it does its work very satisfactorily. The bunch of flax is caught near its center and carried forward, first to one scutching chamber, where one end of the bunch is thoroughly beaten by mechanism within the chamber; it then passes onward to another scutching chamber where the other end of the bunch is thoroughly beaten; it is then delivered from the machine in a fine silky bunch, the work of scutching it having been thoroughly and satisfactorily accomplished. We recommend that a first premium be awarded for this machine.

No. 1371. *Mestizo Burring Picker.*—C. L. Goddard, New York city.

This picker is well known to the public as a most successful and efficient machine. It has been often before exhibited and has taken many premiums. Its well established value could not be enhanced in the estimation of the trade by any premium we might at the present time recommend for it.

No. 1370. *Worsted Burring Picker.*—C. L. Goddard, New York city.

This machine has the same general characteristics as the Mestizo burring picker (No. 1371, *ut supra*), but it is adapted to the preparation of coarser and longer fibers. The feed rolls have longer teeth. The picker cylinder, burr cylinder, brush cylinder and exhaust blower are larger. There are also improvements in the construction of the gratings, to insure the retention of the burrs until the fibers are thoroughly separated therefrom. This worsted machine contains an improvement not found in any previous burr picker, which consists in providing an offset in the framing to receive the heads of the burr cylinder and guards and brush cylinder. In machines constructed in the ordinary way the whole of the cylinder would be within the line of the inside of the frame, and the heads of the cylinders being within that line, would be liable to become clogged by the fibers of wool forced into the spaces between the heads of the cylinders and the inside of the frame, where they are liable to accumulate and heat, and, in connection with the oil of the bearings, become more or less dangerous, according to the care or negligence of the operator. This machine will open the skirtings and cots and tags of Donskoi that heretofore have been worked into the cheapest of filling wool for carpets, thereby adapting the same for like purposes as the body of the Donskoi fleeces. We recommend that Mr. Goddard be awarded a first premium for this worsted burring picker.

No. 1373. *Double Steel Ring Solid Packing Burring Machine;* No. 1374. *Single Steel Ring Solid Packing Burring Machine;* No. 1375. *Steel Ring Feed Rolls, intersecting;* No. 1376. *Steel Ring Feed Rolls, for first breakers, plane;* No. 1377. *Steel Ring Feed Rolls, for second breakers, fine and plane.*—C. L. Goddard, New York city.

These machines were all exhibited at the last preceding exhibition of the American Institute, and were then awarded premiums. They are well known as being the best of their class now in the market both for efficiency and artistic construction.

No. 1372. *Card Cylinder.*—C. L. Goddard, New York city.

The novelty in this card cylinder appears to consist in a combination of wood and metal designed to prevent warping and distortion.

No. 1580*a*. *Picker Band for Looms.*—W. P. Hopkins, Lawrence, Mass.

This device shows an improved method of attaching the picker to the picker stick, a metal link being employed instead of straps and rivets as heretofore. A good and durable fastening is obtained by this improved band, and we recommend that it be awarded a premium.

No. 1580*b*. *Step for Spindles.*—W. P. Hopkins, Lawrence, Mass.

This step is provided with a bushing, which is so constructed that it forms an oil reservoir for supplying oil to the spindle and prevents the oil revolving with the spindle. A concentric grove is formed in the bottom of the step, into which the centrifugal action of the spindle throws grit, dirt and foreign substances entering its step. The bushing may be quickly removed to permit the cleaning of the spindle and its step without disturbing the spindle, and oil may be fed to the reservoir through holes in the bushing without unscrewing the latter. We recommend that this improved step be awarded a premium.

No. 1164. *Cotton Seed Huller.*—Jewell & Ehlen, New York city.

This machine does not properly belong in this group. We have, however, carefully examined it and are well pleased with its operation. An endless belt is employed for feeding the cotton seed to the hulling plates, which latter are made of metal, properly burred for the work to be performed. These plates crack and loosen the hulls from the seed or kernel; and from these plates the cracked seeds fall into a blast, and the heavier particles (the kernels) drop directly down and are delivered from the machine at one side; the lighter particles (hulls and broken seed) are deposited by the blast into a proper screening mechanism which deposits the crushed seeds into one receptacle, and the hulls in another. The machine does its work well and satisfactorily, and we recommend for it a first premium.

No. 1562. *Loom with Independent Motion for Shuttle.*—Jeremiah Stever.

The peculiarity of this loom consists entirely in the shuttle moving mechanism. This consists of a barrel spring which is wound up by a cam at each revolution of the loom. This spring is connected by a strap to the ordinary picker stick, and, when tripped by a finger actuated by the loom, it throws the shuttle with a force entirely independent of the speed of the loom, which force is easily graduated by the operator to give just the right amount of impetus to box the shuttle without endangering the cop by too severe a shock. The result thus attained is of great practical value, improving the quality of the fabric by the uniformity of the tension upon the filling threads, increasing the quantity produced by doing away with the frequent stoppages and smashes arising from the imperfect action of the shuttle motion under a varying speed; and decreasing the amount of waste, by the uniformity and adjustability of the force with which the shuttle is thrown.

The idea of actuating a shuttle by an independent force is far from being new, compressed air and springs of various kinds having been proposed, and in some cases put into actual use. The peculiarity of this device is its simplicity, its adaptability to the styles of looms in ordinary use; and its adjustability to give the exact force required for any given weight of shuttle or width of loom. Not the least of its advantages is that it may be placed in the hands of the ordinary class of operatives. In view of these considerations, we recommend that it receive a first premium.

Yours, very respectfully,

G. H. BABCOCK.
M. M. LIVINGSTON.
JOSEPH TRENT.

REPORT OF THE JUDGES IN DEPARTMENT IV.—Group 7.

The undersigned, judges of Department IV, Group 7, to whom was referred the ice apparatus, No. 1551, and the electro-magnetic regulator, No. 49, beg leave to report as follows:

The Carie ice machine exhibited by M. J. Bujac, Esq., was a practical working apparatus, put up at considerable expense by the exhibitor; it formed the leading feature of interest to the visitors at the fair, as evidenced by the crowds of interested spectators who witnessed the fancy evolutions of expert skaters on the artificial miniature pond, frozen into ice by this ingenious apparatus; this, too, while the general temperature of the surrounding air ranged from sixty-eight to eighty-eight degrees Fahrenheit. Perhaps no better proof of successful result could be given than the fact of producing and maintaining a skating surface in effective order at the general temperature above stated.

In order to determine the economy and practicability of the apparatus for the production of pure ice for refrigerative purposes, it was decided by your judges to take charge of the whole apparatus for a given time and test its capacities. The results obtained from the rigid and carefully conducted experiments, made under the more especial supervision and direction of Prof. Chandler, are stated in his detailed observations hereto appended.

Report of Prof. Chandler.

School of Mines, Columbia College, Corner 49th St. and
4th Av., New York, *January 5th*, 1871.

Dr. Julius G. Pohle, *Chairman Committee on Chemistry, American Institute Fair:*

Dear Sir.—The following are the results of our twelve hours' experiment on the Carie ice machine, exhibited at the American Institute fair of 1870, by M. J. Bujac, Esq.:

The experiment began at 10:45 a. m.; ended at 10:45 p. m.

Ice taken out of freezing box during 12 hours	144	cakes.
Ice in the freezing box at the end of the experiment	18	"
Total	162	cakes.
Ice in the freezing box at the beginning of the experiment	33½	cakes.
Ice actually produced in twelve hours	128½	cakes.
Average weight of the cakes	22½	lbs.

Ice produced	2,891½ lbs.
Say	2,900 lbs.

Coal in the bin at the beginning of the experiment	2,170 lbs.
Coal at the end of experiment	1,622 lbs.
Coal consumed	548 lbs.
Ice produced by each pound of coal	5.3 lbs.

COST OF 2,900 POUNDS OF ICE.

548 lbs. coal, at $6.00	$1 65
Labor of two men	3 50
Wear and tear of machine oil, waste, etc	50
	$5 65
Cost of 2,000 lbs. of ice, or one ton	3 90

The machine is easily managed. There was no apparent leakage of ammonia. No mechanical power is required, except for working a small pump which returns the reconstructed liquid from the absorbtion vase to the retort, in the same manner that a donkey engine supplies water to a boiler. The liquid is reconstructed by the affinity of ammoniacal gas for cold water, and not by mechanical pressure, as in other machines.

On a large scale the ice would be produced more cheaply, as the same number of men could make four times as much ice in a large machine. The quality of the ice was excellent; although the cakes were only three inches in thickness, one of them placed in my refrigerator was not completely melted after three days.

The temperature of the cakes as they came from the machine was twenty-four degrees Fahrenheit, and by sprinkling them with water and piling them one upon another, solid blocks of any desired size were produced. As the ammonia used does not come in contact with the vessels in which the ice is formed, even should there be a leak, the ice would not be affected by it. A leak in the ice mould would simply admit brine, which would prevent the freezing. Hence it is not possible for the ice to be contaminated either by ammonia or by brine.

As the ice is made from distilled water, obtained by condensing the steam from the boiler, its entire freedom from the ordinary impurities of lake or river water is secured.

We were satisfied from our experiment that this process is a simple, successful and economical method for the manufacture of ice of the best quality.

(Signed) C. F. CHANDLER.

The electro-magnetic regulator of Dr. G. M. Steinberg is a highly ingenious and useful apparatus, intended to regulate the temperatures of public and private buildings, for the uses of the chemist and pharmaceutist, and many other purposes. The apparatus is somewhat complex to give a satisfactory explanation of its *modus operandi* in a brief sketch, and we will not here attempt it; but we do not wish to imply by this, that the apparatus is impracticable. We consider it entitled to a high premium.

JULIUS G. POHLÉ.

REPORT OF JUDGES IN DEPARTMENT IV. — Group 3.

To the Managers of the American Institute:

In presenting to you our conclusions, as judges of the sole-leather exhibited at the annual fair in New York, on this the first occasion of a competition for two premiums styled the "Lee" and the "Lorillard" medals we feel that the circumstances of the case calls for some explanation in order that the public and those engaged in the leather manufacture may the better understand the objects sought in founding these medals, and unite in the appreciation of the importance of a project, which, if carried out in the spirit intended, and on a thoroughly understood basis, cannot fail to be of great benefit to an important branch of industry, and advantageous to every member of the community.

The following are the terms of the announcement of these premiums, as made known to the tanners of the country in June last, through the columns of the Shoe and Leather Reporter:

"Gold Medals offered to the Best American Tanners of Oak and Hemlock Leather.—We are authorized by a responsible member of the leather trade to announce, that hereafter he will present through the 'American Institute,' each year two gold medals, one to be known as the 'Lee medal,' to the best hemlock tanner, and one to be known as the 'Lorillard medal,' to the best oak tanner. While it will be desirable that good specimens of the manufacture should be exhibited at the annual fairs of the Institute, it will be understood that the awards will not be made upon a few exceptionally thick and thoroughly tanned sides. The leather exhibited for competition must be *samples* of the whole product of the tanner. These awards will be made under the direction of a committee of the trade, to be selected in the usual way by the managers of the Institute, and if conducted with the enlarged purpose of encouraging skill and merit, as is the design in establishing these awards, we may at no distant period be able to say of the tanning interest of our country, 'while it is second only in importance, it is equal in skill to any mechanical trade in the land.'"

The appearance of this notice, in June last, must at once have suggested to any one at all acquainted with the business of tanning sole leather, that the time allowed for the manufacture of leather intended for competition in the exhibition of this year was so short as to prevent many tanners from taking part in the exhibition. The thorough and careful tanning of sole leather is, as is well known, a work which requires several months, the shortest practicable period for making leather of good weight and even fair quality, by the ordinary methods, being not less than three months, while the usual length of time taken is from five to eight months, and some of our old fashioned tanners even keep their leather from twelve to fifteen months in the different stages of manufacture. Many of our tanners did not, therefore, suppose that it was the intention to award medals on any exhibition of leather made by the Institute this year, and it is on this account, probably, that there were so few exhibitors, in comparison with the great extent of the trade and the number of tanners interested in the matter.

We regret that so few samples have been brought to the exhibition, as an award made on any but a full competition would fail to meet the approval of the trade and would not be of any value to the recipient. In hemlock sole leather the specimens include leather from two only of many hundred tanneries—a great proportion of which, it had been hoped, would be represented—the two competitors being the Wilcox and the Ridgway tanneries of Pennsylvania; it is our opinion that, under the rules of the Institute, and according to the terms of the offer of a medal to be known as the "Lee" medal, above quoted, neither of the exhibitors in this department are entitled to the award as "the best hemlock tanner." From our knowledge of the leather usually sent to market from the tanneries here represented we do not consider these specimens "samples of the whole product" of either, or even of any one invoice of such leather; and while we are aware that the terms under which the medal is offered do not prevent any tanner from sending as fine specimens of his manufacture as possible, which the tanner should always for his own credit seek to do, we do not feel justified in awarding the medal for a "few exceptionally thick and thoroughly tanned sides," as these undoubtedly are, notwithstanding the fact that the tanneries from which they have been sent stand deservedly high.

In the department of oak and mixed leather tannage there is a better exhibition than in hemlock leather, the samples including two tannages of union crop, three of clear oak side leather, and one of oak backs and band leather, with one butt of rough clear oak band leather. While all the specimens are creditable, we do not find that superiority in any one of them, as compared with many well known tannages, to warrant us in deciding, according to the terms of the announcement of the medal, that either of them is entitled to the gold medal as the "best oak tanner." It may, not, however, be out of place for us to designate the best specimens of each particular style of tanning. Of pure oak side leather, the sample of C. B. Williams of Philadelphia (No. 1,360), is, in our opinion, on account of its good color, solidity, closeness of texture and thorough filling out in all parts, including flanks and bellies, the best specimen of side leather; the back and band leather of J. B. Hoyt & Co., New York (No. 1,457), is not in any way inferior in these qualities, and has a firmness and finish that are perhaps even superior, but it must be borne in mind that this leather is tanned from the best part of the hide only, without flanks and bellies. Of the mixed or union tannage of leather we consider the "Wellsburgh," of Messrs. Keese & McCoy, New York (No. 371), the best exhibited, and the leather such as will compare favorably with any tannage of this description in the market.

The samples of leather presented for the Lee medal exhibit two distinct prevailing styles of tannage, the Wilcox representing the non-acid or sweet liquor leather, as it is called, while the Ridgway is of acid tannage, in which the hide is plumped by the use of vitriol preparatory to being subjected to the action of the tan liquors. Each of these systems have their merits and advocates. By the non-acid process the leather is made more pliable, and has a thick grain much sought after by the large boot and shoe manufacturers, as in some cases the grain is so thick that it can be "buffed" to almost any extent in making a good looking bottom. There is very little difference in the market value of leather made by the two processes when equal care is taken in all the operations. The finer qualities of sweet liquor leather generally sell at an advance, as compared with the price of acid leather; but there is so great a demand from the jobbing trade for acid leather, for the supply of all the small shoemakers, that the latter commands a better figure than many tannages of leather made without the use of acid. By the use of acid the leather generally produced is more solid, but has a thin grain, under which, before reaching the texture of the hide, there is a thin layer of a dark color. This is considered very objectionable by the eastern manufacturers especially. A few of the tanners gain nearly the same result of plumpness by the use of old acid liquors in the handlers. *When this is done effectively the grain and buff of the leather is but little better than that of vitriol plumped stock*, and the time lost in the handlers and through the whole process of tanning is equal to forty to sixty days in favor of the vitriol process.

It must be borne in mind, however, in comparing the leather made by these two processes, acid and sweet liquor, that the "gains" made by the former process are considerably better than those made by the latter; the difference, in our opinion, being fully ten per cent in favor of the acid process. In any comparison, therefore, based equally upon "skill and merit," as between these two processes, or any other methods of tanning followed, it is apparent that, in cases where the respective merits of different exhibitors are so nearly equal that no practical distinction can be made, sufficient data respecting the tanning operation should be furnished the judges that they may be enabled more clearly to judge of the skill of the tanner. In this connection, therefore, we would suggest that in future the exhibitor should state, in cases where a premium is contended for on such grounds, rather than in the superiority of all the leather of his tannage, the time occupied in tanning, weight of stock in the hair, "gains" made, and labor and material used. We deem it advisable that some more definite plan should be adopted for the guidance of parties desiring to compete at future exhibitions. And without any desire to dictate to the Institute or to the party offering the premiums we would propose that all hemlock leather competing for the Lee medal shall be specimens made from Buenos Ayres dry hides, as the leather made from this description is regarded as standard in the New York market.

In regard to union leather, or that of a mixed hemlock and oak tannage, we would suggest that, as this description of leather has, to a large extent, superseded pure oak leather in our market, it seems hardly just that this large interest should compete with the pure oak tanners, and the only means of placing tanners of union leather on a fair footing with hemlock and oak tanners will be by an additional premium of equal value, which we hope to see offered either by the Institute or some public-spirited member of the trade.

The announcement that "Lee" and "Lorillard" gold medals were to be given to the best hemlock and the best oak tanners, created, as was natural, no little interest among those engaged in the leather manufacture throughout the country, and there have been many, among whom we might name some who stand very high in the trade, who have from the first scouted the idea that any such competition could be made, with a fair prospect of doing justice alike to the tanner and to the public. But we believe that, by observing the conditions as above explained, holding in mind the spirit in which the medals are to be given, and with well informed and impartial judges, the object of the founder of these premiums may be made of great practical advantage to the trade and to the country. It is true that no two tannages of leather are made in exactly the same way, producing corresponding exact results; but the different processes of tanning are sufficiently well defined and understood to enable those skilled in the business to determine practically the true character of their whole product, whether it shall be of the best, or generally good, or only ordinary, and such as the tanner himself will acknowledge might be greatly improved, and it is by the whole production of the tanner, considered in connection with the means by which he obtains such product, that the judges are to determine who is entitled to the distinction of being classed as first in the respective divisions of this great industry.

Respectfully submitted.

WILLIAM PALEN.
JOHN TUTTLE.
THOMAS KECK.

EXHIBITION ADDRESSES.

THIRTY-NINTH ANNUAL FAIR.

The exhibition of the American Institute for 1870 opened September 7th at the Empire Rink with a good attendance and a fine array of articles on exhibition. Soon after four o'clock Hon. Orestes Cleveland, Chairman of the Board of Managers, called the assemblage to order, made a few remarks, and introduced Hon. Horace Greeley, President of the Institute, who was received with applause, and spoke as follows:

HORACE GREELEY'S REMARKS.

Ladies and Gentlemen.—You see American industry and industrial art represented and typified around you. Though this exhibition in its present imperfect state embodies but a small portion of what American industry and art have produced, yet if you closely examine it you can easily infer the whole. We have representations here of the "infant manufactures" of our country, as they are sometimes called, and as this term is too often applied in derision, I will briefly consider it. Infancy is always relative, comparative. A young elephant may have lived more days than an old cur. So it is with these manufactures. We say that American industrial art is yet young, measuring its duration by that of its rival, its eager and sometimes envious competitors. The lifetime of this Institute has witnessed and measured nearly all of the great triumphs of industrial art on this continent. Yes, when this Institute commenced its public exhibitions, not one-tenth so much, either of metal or fabrics, was produced in this country as there will be in the year 1870. Saying nothing of the railroad whose first locomotive whistled on this continent since this Institute was founded, or of the electric telegraph, a still more recent and marvelous invention, I may safely assert that American industrial art is the growth of a very few of the most recent years. Of iron we are certainly making ten times as much as we did when this Institute was founded, and are proceeding to make more and more with still greater rapidity and energy than in any former year of our country's life. There is a vast variety of American products bounded by a still more recent horizon. Of steel there will be presented here some specimens believed to be better and cheaper than any that can be imported, and of a manufacture which began in the year 1870. Screws, which were formerly entirely imported, are now exported by our people, and it is the same with saws, an immense branch of manufacture only commenced on a large scale in this country within a few years, and now we are nearly if not quite supplied from American sources. Equally recent are those great American inventions which have extended the art of weaving so far beyond the point at which Jacquard left the art. All these are but a small part of the triumphs achieved in this country under the encouragement which our government has wisely, I think, extended to American art. Under this system our oldest manufactures are everywhere the best and cheapest. We all know that in pins, for instance, in spades and shovels, and a large variety of articles, no country takes precedence of ours. To-day British laborers are building railways in Asia and Africa with American shovels, because they are cheaper and better than could be bought elsewhere. (Applause.) But it is said we have still not attained to complete cheapness, and this is said with some appearance of truth. It is certainly true that a ton of American iron costs more gold than a ton of British iron; but it costs less labor. A workman can buy more iron in this country for a week's labor than in any other country where iron is made. Relatively, then, I say we have attained cheapness in all respects, as we have positively in many. If other countries choose to starve their laborers, and so produce certain metals and fabrics cheaply, some say, "Why not buy of them?" In other words, if 200,000 bales of cotton will buy 1,000,000 tons of pig iron, and we cannot make the iron so cheaply, why not raise the cotton and buy the iron abroad? The answers are many. The first is that of Washington; that it is necessary for us to be sure of our supply of a great metal in time of war, and that we never could be unless we produced it. Again, if we make the iron as well as grow the cotton, we have mastered two arts. Whereas if we only grow the cotton, we have mastered only one. We want not only the iron, but the craft and skill of the makers of iron, and we wish to do our part toward the conquest of nature. In the third place, all reason and experience say that the nearer consumer and producer are brought together, the cheaper their products are exchanged, and the larger is the share of the net results that accrue to the producer. Place a continent or an ocean between them, and transportation eats up one-half or two-thirds of the net product of the labor. Bring them close together, and it is very certain they will make their exchanges at the minimum of cost. I could say much more on this subject, but I do not care to prolong these remarks, as there is another prepared to address you, and, moreover, I can be heard at any time. (Laughter and applause.)

Mr. Cleveland thereupon introduced Dr. Geo. B. Loring, of Salem, Mass., who was warmly received, and proceeded to deliver the following:

DR. GEORGE B. LORING'S ADDRESS.

Mr. President.—One of the most extraordinary and attractive phenomena in the history of man, is the co-operative action of the human mind npon the prominent problem of the hour, whatever that problem may be. Controlled, perhaps, by the force of example, perhaps by that subtle and mysterious sympathy which vibrates from particle to particle, until the whole mass is instinct with life; inspired, perhaps, by the divine influence of manifest greatness and power, the popular mind combines all its greater and lesser forces for the solution of the question before it. And the genius of the time is he who, accepting every tribute to the cause, the treasure of the great and the widow's mite, moulds all into expressive form, and inspires and represents the age in which he lives. The problem is presented, and all the divine energy of man sets itself at work upon the solution. The thought that the earth is a terraqueous sphere settles into the mind of the navigators, and unknown and distant seas are vexed at once by a hundred exploring keels, and new islands and continents echo through all their solitudes the voice of advancing man. A sense of beauty calls for expression, and marble and canvas respond to the divine touch. The mysteries of the heavens attract the great observer, and there is no rest until the constellations are mapped out, and the stars set in their appointed places. The human heart is to be unlocked, and the world is filled with the voices of poets and dramatists. The human mind is to be explored, and philosophers and metaphysicians abound. The demands of social comfort, convenience, prosperity and luxury become imperative, and an army of inventors start up, seizing and subduing every natural force to the dominion of the useful arts. And so we divide time, not by the revolving seasons alone, but into divine and immortal periods; into the ages of art, and discovery, and literature, and invention; into the ages of Copernicus, and Columbus, and Shakespeare, and our own age of ingenious and untiring artizans.

Intellectual Accomplishments.

Now, gentlemen, I have assigned this age to the inventors, because to them belongs especially, I think, the merit of having accomplished that which will be longest remembered of us. The time and the glory are especially theirs. I have not forgotten the intellectual accomplishments of our times; the flood of light which science has shed upon the hidden treasures of earth, and sea, and sky; the general diffusion of knowledge by speech, and newspaper, and volume; the audacious spirit of inquiry; the keen and quick recognition of human right; the unerring sagacity of our popular instinct; this social and civil system, untried before, the experiment of our country, which appeals to and develops every human faculty in every human being asking for development. I have not forgotten all this. Neither can I forget the inspiration of our time, as made manifest in art and literature. To us belongs the mysterious genius of Hawthorne, before which the secrets of men's hearts were revealed, and at whose bidding our language was clothed with new power and beauty. It is for us, and our benefit and delight, that Charles Dickens laid bare those human atrocities which lurk under a fair exterior, and find shelter beneath the garb of organized charity and philanthropy. Those great lights, I know, have illumined our heavens, and marked our age, and bound it to the brilliant past. Nor is this all. For I think that, were Plato to appear again on earth, he would enjoy a morning call on Mr. Emerson at his rural retreat in Concord. I have no doubt that Homer would not only find his best translator here in New York, beneath the roof of Mr. Bryant, but that he would also find in that translator an understanding heart. I think that Shakespeare, and Milton, and Ben. Johnson, would be amazed at the lavish supply of thought furnished an eager community by the public press of our day. And I am sure they would all join hands in a pilgrimage to Brooklyn to hear one of Henry Ward Beecher's sermons, especially if Plato or Shakespeare had ever heard one before, and had given an account of it to his companions. It does seem to me that these might be some of the attractions which the great men of former days might find among us. But, however this may be, I am sure that we have before us here a spectacle which would arrest the profound attention of the great men of the past, as it occupies the most vigorous thought of the living—this gorgeous spectacle, the creation of that calm, and well-poised, and acute operation of the mind called ingenuity, that great creative power known as the power of invention.

ART.

Here might the artists of the most artistic age find their master pieces transferred from the canvas by the power of light, and those fruits of genius designed for the palaces of the rich duplicated and reduplicated in startling perfection to adorn the walls of the humblest and poorest, a Sister Madonna for every worshipper, a Claude Lorraine for every lover of nature. Here might the spinners and weavers of ancient fabrics find their skillful fingers outdone by that delicate machinery which is driven by a giant's force, and guided as it were by a giant's brain. Whatever man requires for the gratification of his tastes, or the supply of his comforts and conveniences and most economical necessities, are here provided. And that vigor and capacity of the human mind, which was once applied to adorn and embellish life in its highest walks, is now at work to make life comfortable and beautiful for all. Recall the ancients, and teach them the power of steam; put Columbus on board the Great Eastern; furnish Galileo's tube with Alvin Clark's lenses; send the armies of Cæsar by rail into Gaul; give Homer an edition of the Iliad from the University Press; besiege Troy with iron-clads; clothe the Roman legions from the power looms of Lowell; shoe them from the machinery of Lynn; arm them with the Spencer rifle; heat the houses of Pompeii with steam; light them with gas; send a daily paper to every soldier in the army of Darius; tell Gov. Bradford to telegraph to John Robinson in Leyden that the Mayflower has arrived in port, and has cast anchor in the harbor of Plymouth; and you will then demonstrate to the great mind of old, what untiring and superhuman effort the modern mind has made for the elevation and advancement of mankind.

While we admire, therefore, the accomplished work which lies before us, let us admire also the mental conquests represented here, and that self-devotion and courage which sustains a man amid defeats and failures in this as in the sublimer paths of genius. The heavy burdens borne by the scholar in all ages, by the poets and philosophers, the slow recognition, the tardy reward, the suspense and the anguish, which attend on genius, the world knows too well. But the history of authors is cheerful and encouraging when compared with the injustice and wrong which too often befall the inventor in his work. The sad experience of genius in literature is simply the experience of genius in the arts; and both illustrate the force of that great law that only through pain and trial are the highest accomplishments achieved.

Growth of American Industry.

The rapid growth of American industry, of which this spirit of invention is at once the offspring and the ally, and to the development of which the most powerful of our intellectual forces are now applied, is exciting the admiration of the civilized world. It has never yet been measured so accurately that we could comprehend it in all its proportions. Thus far, statistical estimates have failed to delineate it, and the imagination has been left to supply the deficiency. Mr. F. A. Walker, the general superintendent of the census, and one of the ablest and least prejudiced statistical writers among us, in an admirable article in The Atlantic Monthly, last December, remarks:

"Yet the seemingly extreme case which we have supposed, of failure in the population returns of the eighth census, falls far short of the actual misrepresentation with regard to the products of industry, in the third and largest of the four quarto volumes which embody the results of the enumeration of 1860. Those tables have for years been quoted and indorsed, appealed to and argued from, by editors, economists, and statesmen at home and abroad; they have been used with confidence in ascertaining the law of natural growth; economical legislation has been shaped by them; they have been made the bases of internal taxation, and have governed the distribution of banking capital among the States; yet a few simple tests are sufficient to determine that not two-thirds, certainly, of the national production is represented in these pretentious tables; while it is only the incompleteness of other parts of the work which leaves room for any doubt whether so much as one-half of the actual net product of the country—properly and easily cognizable by the census—receives credit in this account of the national industry."

It may be that these grave faults of the census of 1860 were due to the "capital errors incorporated in the system itself;" but there is another difficulty, which will materially damage the enumeration of any given year as a basis of economical calculations, and that is the rapid increase of our industrial, producing population. It is not simply the increase of our population from 30,000,000 to 40,000,000 in a decade that we are to consider, but also the fact that this is an addition of millions of industrious, active, and in the main prosperous producers—laborers in one form or another, who largely preponderate over those incapacitated by age or feebleness, and included in the aggregate. It is this astonishing increase of producing energy and skill which has secured our success in all the various trials of the last ten years. The enumeration of 1860 would have served this country but a poor purpose in 1865. Our hearts indeed warm over the valor, and devotion, and self-sacrifice, of those five years; our tears still flow for their agony and sorrow; we exult still over the names of Gettysburg, and Vicksburg, and Atlanta, and rejoice with our victorious legions, and worship the names of Wadsworth, and Lowell, and Shaw, and bow before the majesty of Lincoln and Andrew, and adorn with all our affection, and gratitude, and honor, the graves of Farragut and Thomas; for this is our nation's heroism and glory. But we cannot forget that untiring energy, that industrious and unceasing skill, which paved the great highway to our national renown.

THE EFFECTS OF THE WAR.

We began this war, as it were, unarmed. Before it closed, thousands of anvils rang in the construction of every ingenious weapon, repeating rifles, revolvers, heavy ordnance, rifled artillery, which the ingenuity of Colt, and Parrott, and Dahlgren, and Spencer, could devise; a single department, that of General Sherman, employing more than 14,000 mechanics in constant service. Ironclads and monitors swarmed the high seas. The storehouses of the commissary of subsistence groaned with the weight of forage and provisions, which agricultural industry had drawn from the soil, and mechanical industry had transported and stored. And, whether in the manufacture of weapons of destruction, or in the organization of hospitals, or in the management of supplies, or in the work of transportation, or in providing comforts and luxuries for the great mass of our people, there was visible the same well applied and successful industry. I doubt if ever was seen so busy a people as ours, during the four years' conflict, in all the arts of war and peace. I doubt if ever before were the multiplied and various necessities of a trying occasion met with such skill and such marvelous ingenuity. It seemed to be only necessary to name the want, and the supply followed. Entirely new occupations and industries sprang up; but the old ones did not languish. A million of men rushed into the field at the call of war, leaving the land, and the mills, the mechanics' shops, and the schools and professions; and we all expected to see our mills closed and our lands overrun with weeds. But another million went, and yet mills multiplied on every stream; the breadth of tillage land was enlarged; all educational effort increased; church-spires sprang up everywhere; the industrial product of our people was never so great; there were no idlers, or, if there were, they joined the cowards and hid them selves. This is the element in our industry whose power and product cannot be estimated, or which, if estimated to-day, requires a new estimate to-morrow, should to-morrow bring with it an emergency, or an unexpected stimulus; an element peculiarly characteristic of a people, each one of whom is clothed with some responsibility, and enjoys his opportunity to share in the rights and privileges of a free and educated community. That versatility of power which, when one avenue is closed, turns to another, and is never weary in the pursuit of prosperity; what an element of national strength it is, as an attribute of an indepedent people, planted on a broad, and deversified, and abounding continent! Having learned to respect this facility of enterprise, this universal producing capacity of our people in war, I have turned to it with great confidence in all our efforts for prosperous and honorable peace. The magnitude of a burden should always be measured by the capacity to bear it. Mr. Emerson says: "It is as easy for the strong man to be strong as it is for the weak man to be weak." "As thy day is, so shall thy strength be," said the great Lawgiver of Israel.

OUR FINANCIAL CONDITION.

As we comtemplate the rapid development of our industry, and the constant increase of our population, from which no other country has drawn by emigration; and as we witness also our continued prosperity, we may find in this a substantial solution of many of our financial problems, and encourage ourselves with the thought that our growing national wealth, now manifest to all, is the sure foundation of our national credit. I study with interest the various theories advanced for the payment and funding of our national debt, and all efforts to make that debt as light a load as possible. But from all this I turn to our various national industries, with the assurance that in them lies our national strength. I have faith in a busy population. Asking only for economy in public expenditures, for a reduction of all internal taxation to the lowest point consistent with our public necessities, for the protection of every branch of American industry against foreign competition. For such an adjustment of our national debt, as will rest with equal weight upon the resources of the present and the multiplied resources of the future, I can confidently wait for the national growth during the next decade, in every industrial effort which will add to our wealth, and develop the resources of our vast domain. It is not difficult to account for the activity of a people whose territory extending over the best latitudes, and stretching entirely across a continent, is bound together by ample railway communication. Not traffic on the high seas, nor on interior water-courses, constitutes now the most profitable and influential trade of our people. But the great brotherhood of States, one now in social and civil law, one in interest, and made one neighborhood by railroad and telegraph, possesses a vital commercial force, which cannot exist between rival and discordant nations. And so the manufacturer of the north finds a market now almost at his very doors, among the broad agricultural districts of the south and west. Every acre of corn and cotton land can pour at once its products into the channels of trade. There is a local or a distant market for every producer, from which he can choose according to his own best advantage, and the occupation of which, in a profitable manner, constitutes the success of his business. I look, therefore, to the development of this great internal enterprise, aided by cheap and rapid railway communication, and by the most ingenious machinery, for the life of our home market, for the revival and support of our commerce, and for our financial success.

A Few Figures.

It is not necessary for me to enlarge upon the growth of our manufactures, extending now into every State in the Union, and significant of a growing disposition to apply our producing forces to well defined and accurate modes of business. For this you all know, and you know, moreover, that to such enterprise as this we are to attribute the most substantial wealth of our largest cities, even those possessing good harbors, and every opportunity for the best commercial relations. To estimate, moreover, the value of our agricultural products, would not be easy. But I would call your attention to a significant fact in our foreign commerce, and you can then judge how important is this one branch of industry. Agriculture alone, for the accomplishment of that financial success to which I have alluded. The value of the domestic commodities exported during the nine months ending March 31st, 1870, was $370,362,107. Of this, the value of agricultural products was $247,898,814, consisting of beef, $1,362,983; bacon, $5,312,599; cheese, $7,181,640; cotton, $170,182,270; flour, $16,586,174; wheat, $37,536,248; tobacco, $16,601,773; tallow, $3,134,917. The balance of our exports, amounting to about $130,000,000, consisting mainly of products of manufactures and the arts. Taking into account, then, the vast amount of domestic goods consumed by 40,000,000 of people, and the agricultural products, the estimated value of which, in 1869, was $3,000,000,000, necessary for their subsistence, and adding the surplus of each exported, we find ourselves as well prepared to maintain all the commercial relations, and the industries of peace, as we were to bear the burdens of war. May we continue to open our lands, erect our mills, extend our railroads, enlarge our mineral resources, and teach the world that free, self-reliant, well paid labor, the citizenship of a republic of human equality, lies at the foundation of national greatness. It is this alone, which can overcome the obstacles that lie in our path, and open the way for a brilliant future. Already have we taught the world a lesson in political economy, that a nation can afford to bear the burden of a great war debt with honor, and that the industry and labor of a people are a more substantial wealth than the richest rewards of conquest. We have taught the nations that well paid labor, when aided by intelligence, can compete with cheap labor when discouraged by ignorance and subserviency; and that well paid capital, when generally diffused, and aided by a policy which opens a home market, can compete with cheaper capital, which is engaged in enterprises whose markets are scattered over the world. It is a great thing to have a broad and extended country in which to work out such a problem; a country whose lands invite the industrious laborer to comfort and prosperity; a country whose insitutions offer equal protection to all. Fortunate for us is it, that the extent of our territory and the diversity of our interests furnish us with an opportunity to test the great experiment committed to our charge, and to apply that policy of government, which stimulates universal prosperity by protecting every industry alike, and by recognizing the fact that, in a well balanced body, when one member suffers all the other members suffer with it.

The Pride of America.

And now, my friends, I am proud not only of this result of American industry, but I am proud also of the opportunities which go with it. I know there are obstacles in our path, and that our system is not perfect. But, confident that no other system has as yet proved itself to be superior to our own, and content with the prosperity which has thus far gone along with it, I leave it for others to point out the evils which, to their microscopic vision, appear to be hopeless and insurmountable, and to drag us away from the path which has thus far led to success and power. As I look around this hall, filled to overflowing with the fruits of cunning workmanship, I am at a loss which most to admire, the perfection of the work itself, or the relation which it bears to the social and civil condition around us. Go where you will, to England, with its massive and substantial handiwork, and its patient and sorrowful labor; to France, with its superficial glare and fancy fabrics; to Russia, with its gloomy conveniences; to the east, with its gorgeous ornaments; call together the products of these various civilizations, and you will look in vain for the lesson taught by this exposition before you. The effect of the invention, and use of labor-saving machinery in this country, whether it be the design or not, is the enabling of labor to increase its value to the employer. A woman with her needle, for instance, earns a mere pittance in a long and weary day, in which necessary confinement and toil destroy that very physical energy upon which she depends for a subsistence. With a sewing machine, she easily earns a liberal and ample income. A machinist, with the tools in use half a century ago, and unaided by modern machinery, could reap but a small reward. No western farmer could afford to pay the current prices for agricultural labor in harvest time, were he thrown back upon the scythe, the sickle, and the flail. A man, armed with ingenious and well constructed machinery, becomes hundred handed, and he can charge accordingly. It is not the weaving of a few square inches of cloth in an hour, but of yards, which is profitable to all engaged in its production. And, in the same proportion that the rapidity and economy of production are promoted, is the value of the wages earned by the laborer enhanced to his benefit.

THE ELEVATION OF LABOR.

Not to his employer alone, but to himself and his family, are his services made more valuable; inasmuch as the earnings of labor, in many occupations, have generally advanced more rapidly than the cost of living; so that the familiar faces in our saving banks have been and are those of the industrious laborers on the land and in our shops and mills. This is not universal, but it is general. It is, therefore, the double action of machinery which renders it so valuable to employer and employed; enabling the latter to earn good wages, and to use them to advantage when earned. It has already furnished comfortable and comely garments to our laboring population, in place of the coarse and homely fabrics once worn here, and now worn in countries where labor is poorly rewarded. And I have no doubt that it will ere long bring many more luxuries and elegances within the reach of those who were once entirely denied them. It is not the cost of a mere subsistence that we are to calculate in this country, but the amount of comfort and taste, also, which every man can reach. If, by the aid of invention, I can exchange a half-warmed, half-ventilated, half-lighted, and half-furnished dwelling for one in which heat, and light, and air, and every economy for domestic purposes, and cheer and beauty, are to be found, at the same price, I have advanced a long way on the road of civilization. When the necessaries and luxuries of life are made cheap by large and economical production through ingenuity and skill here, it means profit to the producer through lavish and general consumption, and it means an ample reward to the laborer, who toils in the production; when they are cheapened by foreign competition, it means starvation to the producer here, and the poverty of the laborer who, having no opportunity to earn, is deprived of the opportunity to spend. We expect to bring social elevation and domestic comfort within the reach of every industrious and honest laborer. To do this, we must furnish him with the weapons which will at the same time enhance the value of his toil and supply liberally its product.

The relations existing between the employer and the employed in this country differ so materially from those existing elsewhere, that, in all our public policy bearing upon the business of production, we must learn our lesson at home. This is especially true in all agricultural industry. Except in the great grazing and staple-growing sections, it is small farms, on which the owner and the laborer perform an equal amount of work, and where the latter receives a very considerable share of the income in wages and subsistence, that are mainly profitable.

The Situation in Europe.

In Europe, how different. A careful investigation into the system of small landholding in France has satisfied Mr. Howard, an agent sent there for that purpose by the London Farmers' Club, that such a system is a failure, and contrary to the social and civil system existing there. The model farm selected for description in England by Elihu Burrit consisted of 3,000 acres, "a space," as he says, "which thirty Connecticut farmers would feel themselves rich to own and occupy." "Men of skill and experience, who in America would conduct farms of their own, and could not be hired at any price, may be had here in abundance for foremen, at from twelve to sixteen shillings, or from three dollars to four dollars a week, they boarding and lodging themselves." The ultimate ownership of land is with them an impossibility. Labor there means subordination, and throughout Europe a man who has risen to independence from manual labor is looked upon as a curiosity. The wages of manufacturing labor in the great towns of England and France are equally insufficient, an adult earning in England under good circumstances about eight dollars per week, and in France from seventy to eighty cents per day of twelve hours. Under these circumstances it is not surprising that Dr. Playfair, speaking of England, should say: "Our country has shown little inventiveness and made little progress in the peaceful arts of industry since 1862."

In America the principle is and has been entirely different. Mr. Nathan Appleton, one of the founders of cotton manufactures in this country, says: "The introduction of cotton manufacture in this country, on a large scale, was a new idea. What would be the effect on the character of our people, was the matter of great interest. The operatives in the manufacturing cities of Europe were notoriously of the lowest character for intelligence and morals. The question therefore arose, and was deeply considered, whether this degradation was the result of the peculiar occupation, or other and distinct causes. There was little demand for female labor, as household manufactures were superseded by the improvements in machinery. Here was in New England a fund of labor well educated and virtuous. * * * The contrast in the character of our manufacturing population, compared with that of Europe, has been the admiration of the most intelligent strangers who have visited us." Whatever mistakes may have been made, this certainly is the principle upon which the fabric of labor in America has been erected. I shall never forget the delight with which I read a well written periodical published in Lowell by some of the "farmers' daughters" to whom Mr. Appleton referred in the statement which I have quoted. From that day to this, the relations of labor to society have formed one of the most important and interesting problems of the times. It was the existence of this cultivated and independent labor at the north, contrasting so strongly with the subordinate labor of the south, which, as much as anything else, confirmed the faith of our people in the doctrine of human equality, and in the strength imparted to the human mind by clothing it with duties and responsibilities.

Land and Labor.

And now, throughout our country, the two great imperishable treasures are land and labor. Unite the two, and you have the foundation upon which all the more imposing and fleeting fabrics may rest, and for the strength of which the mind of man may exhaust itself in devising means and methods. Intelligent labor, owning a well-cultivated soil—this is the foundation. And around this may gather all the arts of life, in which toil shall receive a competent subsistence, and the hardships of labor may be ameliorated by that mutual understanding which should belong to an intelligent and well-educated community. Without this, we can have no repose, none of those accomplishments to which a free people are equal. If our republic means anything, it means a just understanding of the rights of all; mutual consideration; an opportunity for each, limited only by his faculties; education and respectability for all; and an acknowledgment of merit wherever it may be found. There is a ground upon which all conflict may cease, and the highest prosperity may grow; the ground on which all men stand as citizens equally interested in the welfare of the community. And, next to the efforts which man is making for his ascent into the higher regions of thought, those delicious solitudes with their sacred communion, comes his unwearied endeavor to elevate and refine that practical spirit of utility which "plies the ax in the primeval forests, plows and plants and reaps the field, bridges the river, navigates the ocean, unlocks the gates of mountain chains, explores with groaning enginery the Tartarean depths of mines; drags up the spouting leviathan from the abyss; lifts from the earth, to warm and light our dwellings, great black clods, into which the forests of an elder world have been crushed and condensed; imprisons the mutinous force of steam in iron cells, there to work the bidding of its master; turns brawling rivers upon the wheels of industry; smelts the ore; poises the trip-hammer; forges the anchor; tempers the watch-spring; tips the gold pen with a spark of irridium; touches the needle with magnetic life; stamps thought upon paper; delineates the human face by the solar ray; packs up the ship's longitude in a watch-case; balances the steerage of tall navies on the gimbals of the compass-box, and transmits intelligence by the electric spark from continent to continent, beneath the ocean's bed." All this is the work of mind, indeed; but of mind dealing with material forces and elements to supply wants and avert the sufferings of our physical nature; often, in the individual case, at the cost of greater hardship than it relieves. Man prays to heaven for his daily bread. Heaven showers down no manna upon the waste, but teaches, through the inventive faculties, these bread-giving arts, and clothes the land with plenty.

In its work of inspiring that spirit of invention which strengthens man's hands and elevates labor into the rank where stand the great mental forces which move society, I trust the American Institute will be crowned with success, and will be enrolled by popular consent among the efficient agents of our philanthropic age.

THE SOLIDARITY OF THE INDUSTRIES,

AS ILLUSTRATED BY THE RELATIONS OF THE WOOLEN MANUFACTURE.

An Address Delivered Oct. 13, 1870, by John L. Hayes, Esq., of Boston. Mass.

In presence of these magnificent products of a diversified native industry, at the same time evidences of national progress and inspiration for higher achievements, it would be a waste of words to dwell upon the importance of sustaining upon our soil the general industry which has placed before our eyes these brilliant results. The duty of developing a national industry is not a question for argument. It is a sentiment like patriotism or filial love; and here, at least, we could find few who will not agree with the greatest of living geologists, Elie de Beaumont, that " of all the tendencies which occupy different civilized nations, the most marked is that of fixing upon their own territory all those branches of industrial activity which suit its soil, climate and commercial position; and that government will most preserve the respect of neighboring nations, and show itself worthy of the respect of its people, which shall use all its means of action to favor with discernment this tendency." And few would refuse to partake of the "noble emulation of producing everything," which the venerable Thiers says is possessed by all intelligent and free nations.

"What, then," says he, "are the nations which have sought to develop among themselves a national labor?"

"They are the nations which are intelligent and free. When the foreigner brings them a product, after they have found it serviceable they desire to undertake it. The nations which do not have this desire are the indolent nations of the east. Intelligent and free nations seek to appropriate for themselves the products brought to them by foreign nations."

While the proposition of the importance of a diversified native industry, in the abstract, is generally accepted, the favors which special industries demand from national legislation are frequently the subject of condemnation. We have seen quite recently the copper, the iron, the steel, the woolen, the salt industries, each reproached for the special consideration which they have invoked in legislation. Appearing before you as the representative of a special industry, I offer the apology for my position, and find the guiding thread for my remarks, in the subject to which I now beg your attention: *The Solidarity of the Industries, as Illustrated by the relations of the Woolen Manufacture.* An eminent liberal statesman, who now occupies a place in the new government of France, Jules Simon, closes a recent free-trade speech in the Legislative Assembly by the transcendental remark, "All the liberties are sisters; if we have liberty of trade, we shall have all the others." This remark is only sentimental nonsense, for there is no necessary relation, except in words, between free trade and free government; but, slightly changed, it expresses what I mean by the solidarity of industries. *All the industries are sisters; if we have one, we shall have all the others.*

Let me at the outset exclude the inference that the woolen manufacture is not of itself, and independently of its relations to other interests, of the highest national importance. A manufacture whose direct annual product in the United States is, by the most careful estimates, of the value of $175,000,000, making necessary an importation of only 65,000,000, thus supplying nearly three-quarters of the whole consumption of woolen and worsted goods in the country; which employs directly at least 120,000 operatives, and supports twice as many more; which consumes the fleeces of 35,000,000 sheep; which supplies with cheap and sound clothing the great mass of the people, furnishing nearly all the cassimeres, tricots and cheviots, for business suits; the beavers, moscows and cloakings, for outer garments; the knit goods for under-clothing, and the flannels and blankets for bed coverings; which furnishes all the ingrain carpets consumed here, produced from twice the number of looms that are in England, making the American workingman's parlor and bedroom the most cheerful and attractive that labor ever found for repose; a manufacture which supplies all our delaines, the most largely consumed of the cheaper fabrics for woman's wear, which is daily producing new fabrics for female attire, such as worsted poplins, serges, cloakings, printed cashmeres, alpaca and mohair lusters; a manufacture which furnishes lastings for our shoes, enough for 30,000 a week in a single establishment, reducing the price of the foreign article in two years from one dollar and ten cents to sixty-six cents a yard, which supplies for our furniture all wool and union damasks, silk cotelines, and reps of tasteful designs and beautiful colors; an industry which has torn down the British bunting, which has so long disgraced our national ships, and has run up a real American flag made of our own wools and in our own mills, a flag which means not merely political but industrial independence; a manufacture which in the last five years has made more progress than in any twenty years before, and more than any other branch of textile industry has done, and which by its own grand exhibition in this hall last year won the reluctant admiration of your shrewd importers, and the generous admiration of a diplomatic representative of Great Britain; an industry like this, I say, has claims of itself alone for grateful appreciation by the American people, and for vigorous defense by American legislators.

But I must hasten to a consideration of the indirect and less obvious influences of the woolen industry. And I must be permitted to go beyond our own country and the present time for my illustrations. Let me first show the relations of the wool manufacture to agriculture.

The woolen manufacture works up a fiber which was in primitive times, and is again becoming in quite recent times, the material of the first necessity for the clothing of man. This fiber outranks all others; first, because it is made more perfect than any other, through the chemical elaborations of an animal of high organization, thus surpassing silk, which is derived from an animal of a lower organic structure. Again, its specific gravity being the least of all fibrous substances, its tissues are the lightest, warmest and most healthful. And, finally, this material, provided in some varieties with a structure which enables the fibers to be laced and intermingled, by the process of fulling, into fabrics distinguished for their warmth and softness, in other varieties has a luster which assimilates its tissues to those of silk; and, like silk, and unlike cotton and flax, it receives and permanently retains every tincture and every tone and hue which the art of the dyer can produce. The industrial application in primitive times of this marvelous material to clothing for man, in lieu of the skins of wild beasts, demanded the substitution of the pastoral system for that of the chase, and marked the first step of mankind in agriculture, and consequently in the way of civilization. The whole direct benefit to agriculture from the consumption of wool in manufactured products is measured by the annual value of the wool of the world, which is estimated by M. Moll, chairman of the jury on wools at the Paris exposition, at 3,000,000,000 francs, or $600,000,000. The estimates of Mr. Lynch, approved by Mr. Bond, both high authorities, place the total wool clip of the United States in 1868 at 177,000,000 pounds. At forty cents per pound, the direct value of the American wool manufacture to American agriculture is nearly $71,000,000.

The direct is very far from the only or even chief benefit accruing to agriculture from the woolen industry. The sheep, cultivated in primitive times, and at present in merely pastoral countries for only one of its aptitudes, that of producing wool, is to have a more important aptitude, that of converting, in the shortest possible time, vegetable matter into the most healthful and nutritious flesh; and in countries most advanced in agriculture it has become the most important source of animal food. Again, wool, unlike tobacco, the cereals, the oleaginous seeds, and the vegetable textiles, including cotton, can, so far as is known, be produced and exported indefinitely without creating exhaustion of the soil; and even more than that, sheep, through the peculiar nutritiousness of their manure, and the facility with which it is distributed, are found to be the most economical and certain means of solving the highest problem in agriculture, that of constantly renewing the productiveness of the land. Their manure is more valuable than that of cattle, because they digest better; they cut their food finer and chew it better. They void less vegetable fiber, and their excrements are more converted into soluble matter. "One thousand sheep, folded on an acre of ground one day, would manure it sufficiently to feed one thousand and one sheep. So that by this process land which the first year can feed only one thousand sheep, may the next year, as a result of their own droppings, feed thirteen hundred and sixty-five."

So said Anderson, more than forty years ago; and Sprengel allows that the manure of 1,400 sheep, for one day, is equal to manuring highly one acre of land, which is about four sheep per year. Mr. Mechi, a still more recent authority, estimates that 1,500 sheep folded on an acre of land for twenty-four hours, or 100 sheep for fifteen days, would manure the land sufficiently to carry it through four year's rotation.

Permit me now to present in more detail some illustrations of the relations of the woolen industry to agriculture. I need not say that these relations are reciprocal. Action and reaction are equal in the moral as well as in the physical world. I have elsewhere shown the dependence of the manufactures of each nation upon the wool-growers of their own country, and that the characteristic features of the manufactures of different nations have been impressed by the peculiar condition of their agriculture. I present the same picture, only with the point of view reversed. Manufactures instead of agriculture now occupy the foreground; and the latter, being in distant perspective, are made to appear subordinate to the latter.

The country where the woolen industry has had the longest standing and the most complete development, naturally presents the most complete example of the interdependence upon which I insist. England, from a very early period, has produced sheep of two distinctly marked classes. The one class, thriving upon the dry uplands, produced a short, comparatively fine wool, adapted solely for making fulled cloths. Of this class the original Southdown was a type. This wool supplied the cloth manufactory established at Winchester in the time of the Romans. The other class of sheep, of greater size, flourishing upon the rich, moist plains, produced wool characterized by greater length, strength, and lustre, and its moderate felting properties. This wool, fitted for making serges and other stuff fabrics, adapted especially for female wear, was called combing wool, from the instrument used to make the fibers straight and parallel, preparatory to spinning. Until about the time of Elizabeth, England herself, worked up the greater portion of her short wools into cloths; but exported nearly all her combing wools, far the most valuable of her agricultural products, which were made up into says and serges, by the workmen of the low countries. In the time of Elizabeth, the persecutions of the duke of Alva drove the say weavers, skilled in working up the combing wools, from the Netherlands into England. The worsted manufacture, or that of the combing wools, was thus engrafted upon the industry of England, and prepared the way for the consumption of all her wools upon her own soil. The domestic consumption of all her wools was made a national necessity by stringent laws prohibiting the exportation of wool, which were in force from 1660 to 1825. The prohibition of exportation was especially efficacious in developing the worsted industry, as it compelled the manufacture at home of the combing wools formerly exported. The number of sheep during this period was nearly trebled, and the production of wool in each animal was doubled. As the worsted industry became developed, and agriculture become more prosperous, from the home markets opened for its products, the woolen industry and agriculture continued to react upon each other; the wool manufacture making increased demands for combing wool, or that produced by the heaviest sheep, and agriculture taking a direction to supply this demand.

In the mean time, the artificial or turnip husbandry was introduced by William of Orange, and the means were provided for trebling the number of sheep which an acre of land could support. The results at the present time to the English woolen manufacture are, that the worsted manufacture far surpasses the clothing-wool manufacture, the two together supporting a population of over a million; and the towns which have been the centers of the worsted manufacture have made a more rapid progress than any in Great Britain, Bradford having increased her population 90,000 in fifty years. The result of this reciprocal action to the agriculture of England is a genuine transformation, of external character at least, in the English races of sheep. The production of combing wool, the kind in greatest demand, was secured by breeding sheep which would attain the utmost possible weight of mutton, which could be fed to their utmost capacity, and would produce the utmost amount of manure. The merino sheep, although introduced into England at about the same time as into Germany and France, which they have so greatly enriched, and although their culture was encouraged by the king and and the first noblemen of the realm, were finally wholly discarded. The mutton sheep is at this moment not only the chief animal product of England, but it is what it was declared to be long ago, "the sheet-anchor of English agriculture." It is the chief animal product of Great Britain. The statistics of domestic animals, published by the Royal Agricultural Society, show that Great Britain had, in 1868, 30,711,396 sheep, 5,423,981 cattle, and 2,308,539 pigs. The sheep is literally the basis of English husbandry. The agriculture of England, as a whole, is very simple. Four crops, in regular rotation and mainly in the same order, constitute her great staples. Turnips, barley, grass, and wheat, are said to be the four magical words at which the earth unlocks her treasures to the British farmer. The four field, or four shift system, which pervades the greater part of the kingdom, consists of this succession. The profit is in the barley and wheat alone; the turnips and grass serve mainly to feed the sheep, which furnish mutton and wool to support them in their most important function, that of manuring the turnip field upon which they are folded, for the four years' rotation. It is this function which I wish to bring into special prominence. Recent agricultural writers in England affirm this to be the main object of English sheep husbandry. Professor Coleman, of the Agricultural College of Cirencester, in a paper recently read before the Royal Agricultural Society, on the breeding and feeding of sheep, says: "It is not difficult to show that sheep alone, apart from their influence on the corn crops, will not pay a living profit, after all the expenses of growing the crops are considered." Other practical writers for the same journal declare that there is no profit in growing sheep in England simply for their mutton and wool, but that the culture of sheep is still an indispensable necessity, as there is no other means of keeping up the land.

Passing away from England, I observe that the highest authorities in France inculcate the same lesson. The most eminent of French practical statesmen, M. Thiers, in his great discourse on the protective question, delivered in the Legislative Assembly in January last, demands protective duties upon the wool of France; as it is threatened that the fine sheep, unprotected through duties on wool, must disappear from the soil of France, in consequence of competition from the southern hemisphere. He says: "Upon four-fifths of the territory, where the soil is stony, and only fine grasses abound, the fine sheep alone can convert this grass into flesh and manure." After giving the facts as to the decline of the ovine population of France, and its enormous increase in Australia and La Plata, he continues: "In this situation, how can the French resist the foreign competition? *The agricultural industry of France cannot dispense with sheep.* The facts which I have given you ought to inspire you with the most serious concern." The same lesson is taught by the best practical agriculturists of the United States. Mr. Stilson, president of the Wisconsin Wool-growers' Association, has shown that his flock of 1,500 sheep has enabled him to produce eight or ten more bushels of wheat to the acre than is grown on the average lands of Wisconsin, where sheep husbandry is not an auxiliary to wheat farming. The president of the Ohio Wool-growers' Association, Mr. Stevens, whom I had the pleasure of meeting this summer at the Indianapolis exposition, assured me that he could see no means of reclaiming the rapidly deteriorating lands of Ohio except by the restorative influences of sheep husbandry. We have seen lands in certain portions of the west producing wheat so abundantly as to compel the opening of railroad lines for the single purpose of transporting their teeming harvests; and have also seen, in our own time, these very lands so rapidly exhausted that the rails have been torn up for want of traffic. Such facts apprise us that there is no security for continued fruitful ness, even in our most fertile States, but in a more provident agriculture. What is taken from the land *must* be restored. Science gives us but little encouragement in the promise of cheap imported or artificial manures. The guano beds are being rapidly exhausted. The experiments of Messrs. Lawes and Gilbert, at Rothamsted, show that the application to the land of sewage from the cities, from which so much was expected, is a failure. The brilliant experiments of Vila, in France, made to exhibit the applicability of artificial manures in place of animal manures, in countries like France, where the land is so much divided as not to permit the profitable culture of animals, lead to no practical results, because no economical sources of artificial nitrates, phosphates, or potash, have been or are likely to be discovered. We see, but as through grated windows, exhaustless but practically inaccessible stores of potash in the granite rocks; of phosphates in beds of apatite; and of nitrogen in the atmosphere, or in the far-off rainless plains of Chili. Has not Providence locked up these treasures, or removed them from our reach, to compel man, for his highest physical good, to cultivate the animal which best supplies the primal necessities, food, clothing, and the continued enrichment of the earth? The blessing, in the olden time, was given to him who "brought of the firstlings of his flock," for "the Lord had respect unto Abel and to his offering."

There are other relations of the woolen industry to agriculture, much less broad in their scope, but so interesting and illustrative that I cannot pass them by. The first which I allude to, because connected with the topic which we have just considered, is the achievement which chemical science has recently effected in saving the potash contained in the yolk of fleeces in such a form that it may be returned to the soil or used in the arts. It is well-known that sheep draw from the land upon which they graze a considerable quantity of potash, which, after circulating in the blood, is excreted from the skin with the sweat, in combination with which it is deposited in the wool. The French chemists, MM. Maumoné and Rogelet, have established quite recently at the great seats of the woolen manufacture in France, as at Rheims and Elbeuf, factories for putting the new industry which they have created into practical operation. They induce the woolen manufacturers to preserve and sell to them the solutions of yolk obtained by the washing of the raw fleeces in cold water, and pay such a price as encourages the manufacturers to wash their wool methodically, so as to enrich the same water with the yolk of a number of fleeces. These scourings the chemists carry to their factory, and then boil them down to a dry, carbonaceous residuum. The alkaline salts remain in the charred residuum, and are extracted by lixiviation with water. The most important of the alkalies obtained is potash, which is recovered in a state of great purity. It is computed that if the fleeces of all the sheep of France, estimated at 47,000,000, were subjected to the new treatment, France would derive from this source alone all the potash she requires in the arts, enough to make about 12,000 tons of commercial carbonate of potash, convertible into 17,500 tons of saltpetre, which would charge 1,870,000,000 cartridges. So that the inoffensive sheep, the emblem of peace, can be made to supply the chief muniment of war. The obvious lesson from these facts, to the sheep farmer, is to wash his fleeces at home, in such a manner that the wash water, so rich in potash, may be distributed upon the land as liquid manure.

I have already adverted to the influence of the wool manufacture of England in developing the breeds of long-wooled sheep in that country. Facts illustrative of the influence of manufacture upon sheep husbandry are furnished by all manufacturing nations In the indolent nations of the east, manufacturers adapt themselves to the raw material which has been furnished for ages. The beautiful Turkish carpets of Asia Minor are produced now, as they doubtless were in the time of the Crusades, from coarse wool grown upon the Barbarous broad-tailed sheep, which is still precisely the same as those which formed the flocks watched by the shepherds of the Bible, and to which belonged the Paschal lamb. Nations of higher civilization are constantly varying their fabric and their sheep husbandry.

The Spanish merino, which I conceive to be a relic of Greek and Roman civilization, preserved in the mountains of Andalusia from the barbarians who swept over most of the Roman possessions, was introduced about a century ago into all the manufacturing nations of Europe. When introduced into France, at the sheep-folds of Rambouillet, it produced a short clothing wool. Let me, before describing the important change which subsequently took place, advert for a moment to a zoölogical principle.

A beautiful law of nature has been brought into view by the studies of modern zoölogy, that, while the primary and specific characters, determined by the forms of the skeleton, are absolutely fixed, and transmit themselves infallibly by generation, the secondary or accessory forms of animals, such as the fleshy covering, hair and fleece, the only characters which man has in view in cultivating the domestic animals, can be modified indefinitely by culture. For example, the sheep in a state of nature is provided with two kinds of covering. The outer or principal covering is a coarse hair. Beneath this hair, and concealed by it, is a short, fine down. It is this down, which, by the culture of sheep in a state of domestication, has become the wooly fleece, and which is again susceptible of being modified by the climate in which it is developed, or the care of which it is the object. This modification of the secondary characters of animals is sometimes the result of high agricultural skill, or, to use the more accurate modern term, *zootechnic* skill, directed to a specific object, as in the labors of Bakewell and Elman, in England, and of Hammond in Vermont. But the modification generally takes place insensibly.

One of the most important of these insensible influences is that which the wool manufacture exerts in its demand for the material for its fabrics. The merino, as I have observed, when introduced into France was small, short-wooled sheep. The higher feeding naturally given to the precious animals necessarily tended to increase the size, and at the same time to lengthen the fiber, it being the fixed law that woolly fiber is increased in length but not in diameter by increased nourishment. French industry, with that creative genius which is its highest attribute, saw in the newly acquired fiber a means for creating new, soft fabrics for female wear, in place of the coarse and stiff serges which were the characteristic stuffs of the former country. Here was a fresh raw material for the novelties in dress which the world of fashion is perpetually calling upon France to supply. Remember that before the present century no female stuffs were made of fine wool. In 1801, Dauphinot Pallotan invented the most beautiful of all woolen tissues, the *French merino*, at present, or recently, the chief product of Rheims and its 50,000 workmen, and the sole product of a single establishment at Cateau, with 10,000 workmen. In 1826, M. Jourdain invented all-wool *mousselines de laines* for printing, the material being long merino fleece. In 1838, he created *challis*, a fabric with a warp of silk orgazine and a weft of merino wool. Since then the dress fabrics of which merino wool forms the chief component material have been infinitely varied to meet the insatiable demands of fashion for change. The exposition of 1867 demonstrated that of all the fabrics which the art of man has produced, there are none which bear comparison in tastefulness, variety, and perfection of workmanship, with the French dress tissues of merino wool.

The demands of the wool industry of France gradually and insensibly converted the fiber of her merinos into combing wool. The wool could not be made to acquire the length required for combing without increasing the size of the animal. The merinos of France are the largest animal of their race in the world. They are said t(be, as compared with the American merino, bred for a different purpose, "what the great, pampered short-horn of England is to the little, hardy, black cattle of the Scotch Highlands." The influence of French manufacturers has extended even to the sheep husbandry of the southern hemisphere. As the fine combing-wool industry of France was extended, her own wools became insufficient to supply her looms. Regenerators of the Rambouillet stock were largely introduced into Australia originally producing only clothing wools. The wools of Australia have become lengthened in their fiber, and the exports of Australia, according to M. Moll, are now principally destined for the combing-wool industry.

The peculiar necessities of the French woolen industry have led to one of the most remarkable zootechnic achievements, and one which could not have been effected without the auspices of the manufacturer, the creation of a new race of sheep and of an absolutely new fiber. The enormous prices of Cashmere shawls stimulated the French manufacturers in the early part of this century to emulate the Indian tissues. They succeeded perfectly in the fabrication. They induced, also, the importation of a large number of Cashmere goats, the animals furnishing down from which the Indian shawls are fabricated. It was found, however, that the goats could not be cultivated with profit, as each animal produced only three or four ounces of down. In 1828, there was accidentally produced at the farm of Mauchamp, cultivated by M. Graux, a ram of the merino race which, besides other peculiarities or monstrosities, was provided with a wool remarkable for its softness, and above all for its luster, which resembled that of silk. By a system of careful breeding, M. Graux succeeded in obtaining a small flock of animals from this stock whose wool was perfectly silky. He at first met with but little encouragement. The ordinary manufacturers, to whom he offered his wool, complained that it was so pliant and slippery that nothing could be done with it. Fortunately, the silky wool attracted the attention of M. Davin, a wool manufacturer familiar with the fabrication of the Cashmere fiber, and distinguished for his zeal and skill in introducing new material into the textile arts. Taking the silky wool in hand, he succeeded in making magnificent stuffs which won the admiration of connoisseurs. Merinos, mousselines, satins of China, and shawls, made of this material, equaled, if they did not surpass, analogous products made of the finest Cashmere yarns. "The silky wool," says a report of the Imperial Society of Acclimation, "is destined to replace completely in our industry the Cashmere wool which comes from Thibet. It is fully as brilliant as Cashmere and as soft, while it costs less as a raw material, and requires less manipulation to be transformed to yarn."

The Mauchamp or silk-wooled race of sheep is now definitely established. I need not say that this beautiful creation could not have been effected in a country where the arts were not already developed to apply it.

The merino sheep, introduced into Germany about the same time as into France, received an improvement in an opposite direction. This direction was mainly given by the demands of the German wool manufacture, though partially due to a dry climate and unfruitful soil. Germany was already provided with sheep-producing coarse clothing wool. They continued to suffice for the clothing of the great mass of the people, who were not elevated and wealthy as they have since become through the influence of the protective Zollverein, nor educated, as they have since been in Prussia, through the wise counsels of the immortal Humboldt. The early woolen manufacture of Germany was directed to the supply of cloths for the more wealthy classes. The combing-wool industry had been scarcely attempted. The first demand of the manufacture, therefore, was for fine clothing wools. The German flock-masters, being generally wealthy landholders, possessed the ability and intelligence to respond to this demand. The ideal in sheep husbandry became the production of the finest possible fiber. The ideal has been completely attained. The characteristic wools of Germany, those of the electoral race, are much finer than those produced from the original Spanish stock; and the animals are much smaller in size, while the fleeces are correspondingly small. The extremely fine fiber, designated in Germany as *noble wool*, is marked by the distinctness and great number of its curves or wrinkles. The wools are distinguished not only for their fineness, but the extreme shortness of their staple, which give the felting qualities essential for the fine broadcloths and doeskins, for which German manufactures are so celebrated. These wools bear the highest price of any known, although the profitableness of their culture exclusively is questioned even in Germany. Still they form a leading source of German wealth. Eighteen per cent of all the exports of wealthy Prussia consists of woolen manufactures, and those principally fine cloths. Thus we have a manufacturing industry acting directly upon agriculture; this reacting in its turn upon manufactures, until a distinct physiognomy is impressed upon the German national fabric, and the chief agricultural distinction of Germany has become that of possessing the most perfect fine-wool husbandry of the world.

Results quite different, but no less distinctive, have been effected by the influence of the woolen manufacture in the United States. Sheep husbandry in this country has been hitherto pursued exclusively with a view to the production of wool, mutton being a mere incident, and manure hardly a matter of consideration. The character of our sheep husbandry has, therefore, been wholly determined by the demand of manufacture. The American manufacturers have found it more profitable to run their mills upon the classes of goods in demand by the mass of our people. The masses of American consumers, although not demanding superfine cloths, require goods of a better and finer class than would content the masses of European population. Sound and sightly cloths, but of medium fineness, are in the greatest demand. Medium wools, produced by merino grades, of considerable length of fiber, are well suited to the production of flannels and fancy cassimeres, our principal products in the clothing-wool manufacture. It is true that the fine broadcloth manufacture was attempted under the fostering influence of the protective tariffs of 1824 and 1828, and was further extended under the tariff of 1842; and the culture of Saxony or superfine wooled sheep was pursued with enthusiasm. The horizontal tariff of 1846 destroyed the broadcloth manufacture, and at the same time swept away our Saxony sheep or merged them into coarser flocks. The demand for broadcloth wools having ceased, the American breeders of merinos, adapting themselves to the wants of manufactures, sought to produce a coarser and longer staple than had been in request at an earlier period. They have produced, through these influences, a race of sheep designated as the American merino and now recognized as a distinctive variety, like the Saxon merino or French merino. The most complete account of the American merino is the elaborate paper furnished to the report "On Wool and Manufactures of Wool," at the Paris exposition, by Dr. Randall, the highest American authority on sheep husbandry, and no less favorably known as author of the Life of Jefferson. The remarkable improvement in productions of wool, effected by American husbandry upon the original Spanish stock, is the most interesting fact brought out in this excellent paper. From facts and experiments in scouring which he details, Dr. Randall says: "It appears, first, that prime American merinos produced more *washed* wool, in 1844–46, than was produced of unwashed wool by the original stock in Spain, at their palmiest period; second, that prime American merinos produce about as much scoured wool now as they did of washed wool in 1844–46, and nearly twice as much as the picked merino flock of the king of Great Britain from 1798 to 1802. They undoubtedly produce twice as much scoured wool as the average of the prime Spanish flocks of that period." By breeding to produce heavy fleeces, the wool of the American merino has become elongated so as to make it a true combing wool. No use of this quality has been made until very recently, except in delaines, a comparatively low fabric. The American commissioner at the Paris exposition, in the department of woolens, who, though largely interested in manufactures, had at that time but little practical experience in fabricating, was fascinated by the magnificent French merino fabrics at the exposition. Upon his return to this country his attention was drawn to a fleece of American merino wool, which had been sent from Ohio to the office of the association which I serve, to illustrate the combing qualities of the American staple. He instantly resolved to emulate in the mill of which he had the direction, with our merino combing wools, the French fabrics which he had admired abroad. Within less than two years the resolution has been crowned with complete success; his establishment has achieved several entirely new dress fabrics, made wholly of native fiber, such as had never been attempted in England, and at least 3,000 pounds of American merino clothing wool are consumed per week in this new fabrication. This achievement I regard as *the* event in this year's history of the woolen industry of the United States. Perhaps I may be excused for recalling in this connection an intimation which I made in a published address five years ago: "The true value of the fleece of the American merino is for combing purposes, for which it has a remarkable analogy with that of France. This country will never know the inestimable treasure which it has in its fleeces until American manufacturers appropriate them to fabricate the soft tissues of merinos, thibets and cashmeres, to which France owes the splendor of the industries of combing wool at Paris, Rheims and Roubaix."

The relations of our industry with agriculture are so fascinating that they have too long detained me from the most important branch of my subject, the relations of the wool manufacture to the higher arts and the other mechanical industries. As the oldest of textile arts, the woolen industry has filled the pages of history with illustrations of its civilizing influences. Passing by the voyage of the Argonauts for the golden fleece, and the fruits of that expedition, the birth of the arts of navigation and the origin of Phœnecian letters, a fable, indeed, but one teaching the same lesson which I would inculcate; passing by Tyre, enriched by the commerce of its murex-dyed tissues and fleeces; the Italian States, Florence, Venice, Pisa, and Genoa, which were the first in the twelfth and thirteenth centuries to appropriate the arts which the Crusaders brought back from Asia, and who found in the woolen manufacture the source of the wealth whose fruits survive in the "stones of Venice," and the wonders of Florentine art, for Michel Angelo's great statue of David was paid for by the wool-weavers' guild; passing by Flanders, where the growth of the wool manufacture and of Flemish art were cotemporaneous, and which subsequently became the center from which the art of fabricating woolens spread into England, France and Germany, turning aside from these brilliant examples, I would point you to a homely and familiar illustration at our own doors of the indirect influence of the woolen industry upon the sister arts.

Mr. Benton has pointed out with singular felicity the successive events which mark out the routes of the great railroad lines across the continent; first the path of the buffalo, then the Indian's, then the trapper's trail, then the emigrant's wagon and dawning civilization, and finally the railroad train, and civilization accomplished. Manufacturing industry has been established by a similar succession.

Settlements are made in the beginning upon our water courses. Water power is first applied to the saw-mill; then comes the grist-mill; then follows the woolen-mill; in old times it was the fulling-mill. The fulling-mill was, and the woolen-mill now is, to a matured industry, what the emigrant's wagon is to the great interior, the dawn of manufacturing enterprise, as that is of permanent settlement. The cotton, the machinery, the iron, the silk, the paper manufactures follow and build up our Lowells, Patersons, and Manchesters. This is no fancy sketch. I remember the time when the Salmon Falls river, watering a district which was occupied by one of the earliest and most important settlements in New England, dating back to 1632, had no other manufacturing establishments than a saw-mill, a grist-mill, and a fulling-mill. The latter disappeared, and was succeeded in 1828 by a well-appointed woolen factory. Afterward came the cotton-mills of Great Falls; and the Salmon Falls river moves now 132,000 cotton spindles and fourteen sets of woolen machinery, This is but a type of the march of manufactures everywhere in this country. The first textile manufacturing establishment in Massachusetts was a fulling-mill, built at Rowley, near Ipswich, in 1643. This was the pioneer of a textile industry in Massachusetts, which, according to the commonwealth returns in 1865, amounted to $144,730,679. The woolen-mills in the north-west, California, and Oregon, are in their turn the pioneers of a diversified industry in the newly settled States. The erection of a woolen-mill of two or four sets seems to us at the east but a trifling affair, but to the new States it is an epoch› the dawn of manufactures, which all experience tells us will expand into a largely diversified industry and its attendant results, a superior civilization. The historian, Thiers, chronicles a more insignificant event than the building of a four-set mill, as an epoch in history. The introduction of a little manufacture of cloths, at Abbeville in France, by Colbert, is recorded as a more important conquest than that of his master, Louis XIV, who struck down the Spanish power. I have mentioned the fulling-mill as really the pioneer of the textile industry in this country. Few have a conception of the very brief period within which the woolen industry has attained its present development. A hundred years ago in England, and fifty years ago in this country, the woolen manufacture, as it now is, had hardly an existence. The spinning and weaving of wool was simply a domestic industry, power being used only in the fulling-mills. Dyer, despised by Dr. Johnson as poet, because his subject, the fleece, partook of "the meanness naturally adhering to trade and manufactures," but now regarded as a better poet than the great critic, and also as the best annalist of the industry of his time, describes the manner in which the products of the woolen industry were collected, a century or more ago, for British commerce :

"From little tenements by wood or croft,
Through many a slender path, how sedulous,
As rills to river broad, they speed their way
To public roads.
And thence explore,
Through every navigable wave, the sea,
That leaps the green earth 'round."

Some of our leading living wool manufacturers were apprenticed in their youth to clothiers, or the workers of the old fulling-mill; and one so apprenticed, from whom I recently sought reminiscences of the early manufacture, well remembers the farmers of Connecticut trudging miles through the woods with rolls of cloth upon their shoulders, to be felted and dressed in the fulling-mill. We sometimes regret the Arcadian days, when

"Maids at the wheel, the weaver at the loom,
Sat blithe and happy."

But considering the matter more practically, how vast an improvement upon this toilful and unproducted industry is that of the present time, when a single establishment, such as the Washington Mills, of Lawrence, Massachusetts, with its hundred sets, was capable, according to the statement of its late lamented treasurer, Mr. Stetson, by working day and night, to produce all the woolen clothing for an army of a 1,000,000 men.

Let me give the relations of the woolen manufacture to particular textile arts, and first to the cotton manufacture. The cotton manufacture of Great Britain, the most stupenduous phenomenon of modern industry, was the natural offshoot of the woolen manufacture. Through the woolen trade, mainly, England had become a nation of spinners and weavers, or of artizans subsidiary to them. A national taste and skill had been developed in the textile arts by the manipulation of wool, which was readily applicable to a kindred fiber. Many of the inventions upon which the cotton manufacture is dependent, such as the invention of the fly-shuttle, which doubled the power of the weaver and made necessary the subsequent inventions which increased the spinning power, were contributed directly from the seats of the woolen manufacture. What was scarcely less important, the commercial connections established by the woolen trade gave to the cotton manufacture, when completely inaugurated by the inventions of Hargreaves, Arkwright, and Compton, a command of foreign markets for unlimited exports of the new British textile. The British cotton manufacture is as truly the offspring of the woolen industry as New England is of Old England. This may be called the most important incident of the woolen industry; for in giving birth to that of cotton, it secured to England, from the fabrication of that textile, a profit in fifty years of *one thousand million pounds sterling.* Pursue these consequences still further, and we have the cotton gin in America, the growth of the slave power, its aggressions, the war of the rebellion, and emancipation!

The cotton manufacture, reaching maturity, discharged its filial debt by giving an unexpected and singular development to the woolen industry.

Between 1830 and 1840, cotton became an important auxiliary to wool, through its use in warps for woolen or worsted filling in the fabrication of tissues for female wear. Many varieties of these union fabrics are classed under the generic name of cotton delaines. This fabric was first introduced into France in 1833, and into England in 1834. It is practically the same as a woolen fabric, the warps being so covered with wool that the presence of cotton can be observed only by the closest inspection. Its cheapness, durability, and slightliness, when printed, make its introduction an invaluable boon to women of moderate means. Not less than 60,000 yards are annually manufactured in this country, and the cheapness and excellence of the American fabric practically excludes its foreign rivals. The cotton warps are now used as vehicles to extend the surface of wool and worsted mohair and alpaca in a countless variety of dress fabrics. The wool of a single sheep may be extended by the cotton warp so as to fabricate 672 yards of so-called alpaca fabrics, enough for fifty-six dresses. All the cheaper fabrics are made by this wholly modern alliance of wool and cotton, and the great manufacturing cities of Bradford, in England, and Roubaix, in France, are chiefly occupied in the fabrication of these cheap tissues, whose undoubted fragility is rendered less objectionable by the fickleness of female fashion.

An establishment producing fabrics of this class will give us the best illustration of the manifold and important relations of the woolen industry of the present period. I select the establishment known as the Pacific Mills, located at Lawrence Massachusetts, because it is the oldest and largest of its class. This establishment turns out an annual product of printed delaines and calicoes, principally the former, valued at not less than $7,500,000. In the production of its union fabrics the mill works up each year 3,500,000 pounds of fleece wool or the fleece of 10,000 sheep each week.

For washing this wool it makes and consumes annually 250,000 pounds of soap, composed by the domestic products, lard and caustic soda. It combines with this wool, in the form of cotton warps, 3,500,000 pounds of cotton.

In the processes of spinning and weaving it expends 12,000 gallons of lubricating oils and 10,000 gallons of olive oil.

The raw materials for dyeing and printing, such as soda ash, sulphur, prussiates of potash, the various preparations of tin, the dyewoods, indigo, cochineal, yellow berries, and aniline colors, etc., require an annual expenditure of $400,000. The consumption of potato starch is 500 tons a year, or the product of 125,000 bushels of potatoes. Thirty thousand a year is expended in lumber and nails for packing boxes; an expenditure which, in twenty years, would build up a considerable town. As much more is expended annually in iron, steel, lumber, and paints for repairs; 14,000 tons of coal are consumed yearly, although the motive power of the mill is water. To this may be added the food and clothing of 3,600 operatives and of their dependents, at least twice as many more, and the items of transportation of raw material and manufactured products. Considering these multiform relations, how vast is the wave of production set in motion by the wheels of a single mill, and how broadly extended are its ever-enlarging circles; for the materials of consumption above enumerated show that the productive stimulus of this industrial center moves labor, not only in fields of the south and the pastures of the west, but in the plains of India, the forests of Brazil, and the islands of the equator.

The wool manufacture makes itself auxiliary to other textile arts as to those of linen and silk. The flax or linen manufacture is particularly allied to that of wool in the production of Brussels and tapestry carpets. A single Brussels carpet factory, producing 550,000 yards of carpeting, consumes annually a quantity of linen warps of the value of $150,000. Another establishment, making principally tapestry, Brussels, and velvet carpets, to the extent of 818,000 yards, besides 30,000 yards of Brussels, consumed for the filling and backs 793,866 pounds of linen yarn and jute, costing $167,000, besides 202,000 pounds of cotton yarn for warps, costing $90,000.

The silk manufacture is an important contributer to the woolen industry. One form of the alliance of silk and wool is the silk poplin, the warp being of long combing wool and the weft of silk. This tasteful, though useful fabric, is now largely produced in Connecticut and New Jersey, and the American production compares favorably with the celebrated poplins of Ireland. Another form of this alliance is the silk-warped flannel, now produced in our mills in connection with the manufacture of the beautiful opera flannels, formerly brought exclusively from France.

The most important form is the silk-mixed Cassimere, the alliance of silk with merino wool, through the infinite combinations made by our Crompton mule-producing fabrics, distingüished for their subdued luster, and the softness of their neutral tints. A single manufacturing house of your city, whose silk and wool mixtures are admitted to vie with those of Elbœuf, and which, as I shrewdly suspect, the dealers, not the manufacturers, usually sell as such, consumes annually $150,000 worth of American silk organzine. The whole amount of silk consumed by our mills is estimated by good authority at not less in value than $1,000,000.

I can barely refer to two other very important industries, one of which is directly in one department, and the other mainly founded upon our wool manufacture, the manufacture of hats and that of ready-made clothing. The former, in one of its branches, that of wool hats, and in the first part of its processes, the preparation of raw material, is really a branch of the wool manufacture. It is too important a branch not to be referred to, as the annual production of wool hats in the United States exceeds in value $10,000,000. The industry of ready-made clothing, dating back no further than 1824, and now the most important single one of our city industries, obtains its supply of material substantially from the American wool manufacture. The official statistics of Massachusetts for 1865 show that this industry in the city of Boston alone yielded a production of $15,186,833, and employed 1,479, males and 19,205 females. If the production in the other cities is in the same proportion, the part which the offspring plays in supporting American labor is scarcely less important than that of the parent industry.

I have not time to trace the relations of the woolen manufacture to the chemical arts, nor to follow in any detail the progress of discovery from the period of the great impulse given by Colbert, who, in introducing the woolen manufacture into France, made improvement in the art of dyeing the object of special care, considering, as he happily says, "dyeing as the soul of tissues, without which the body could hardly exist." The discovery of Prussian blue in 1704, of chromium in the latter part of the century, the fixing of color by means of steam in 1810, the application to union fabrics in 1857, the discovery of alizarine in 1826, of murexide, the reproduction of the Tyrian dye in 1856, of aniline dyes from coal tar in the same year, and finally the most brilliant chemical discovery of the last two years, that of producing from coal tar the coloring principle of madder, alizarine, a discovery of such practical value that the product of the coal fields is already replacing the product of the madder fields among the Scotch dyers.

Most of these discoveries have had their impulse, as the great industries which supply the materials for dyeing have their support, in the textile arts, and principally in the woolen industry, which makes the largest application of color.

I must hasten to my final illustration; the relations of the woolen manufacture to the industries producing machinery. In this view I do not regard of chief importance the many special industries directly and exclusively employed in constructing machinery and supplies for our mills, although the capital and labor which they employ make them worthy of more than a passing notice. A few establishments construct all the classes of machinery made use of in our mills. But generally the work is divided. Some build only pickers, others carding machines, others jacks, others looms, others shears.

Others make supplies for both woolen and cotton mills, as card clothing, reeds, harnesses, shuttles, bobins, spools, and belting. The bare enumeration shows how important is this direct relation of the woolen manufacture. But I desire in closing to call your attention to a broader view, and therefore will not separate the woolen manufacture from the other textile arts of which it was the pioneer.

The textile industries of the wool and cotton made in England during the last century, the first extended application of the new motor power, steam, which, for some time after its appearance, had been condemned to a sort of obscurity by being applied only to the drainage of mines. The power of steam was first made *conspicuous* by the woolen and cotton mills. The factory system and the movement of textile machinery by power demanded the construction of great numbers of pieces of machinery of the same dimensions, and also the construction of works of nice mechanism, which the mere hand-craftsman, the whitesmiths of a former age, could not supply in sufficient number, nor with the requisite precision of construction. Machine shops were, therefore, erected upon a large scale, to be moved by power. It is well known that the great machine shops of this country arose contemporaneously with the factories in Providence, Lowell, and Philadelphia. The necessities of the textile manufactures, then, and for the first time, called into existence the automatic mechanical contrivances called machine tools and engines; the planers and lathes and steam hammers which substitute the firm, *iron arm* for the weak and uncertain human hand, contrivances which have caused the disappearance, in the manufacturing world at least, of the file, the plane, the chisel, the auger, the drill, in the hand of man, except for the most trivial and unimportant purposes. The power and accuracy of constructive art were thus marvelously extended. Masses of iron of thirty or forty tons' weight are wrought and transformed with more facility and in less time than a bar of a few hundreds' weight could have been fifty years ago. The precision of construction attained is so perfect, according to President Barnard, the chief ornament of the science of your city, who has suggested much which I have just said, that the dimensions of a required piece of work may be gauged to the one-millionth part of an inch. The machine tools, created by and for the textile manufactures, were now ready for new applications. River and lake steamboats, locomotives, ocean steamers, monitors, appeared in succession, the methods of interior transportation are revolutionized, and the entire naval marine, and almost entire commercial marine of the world are completely transformed. In all the manufacturing nations, and particularly in our own, a passion for invention has been developed with the new facilities for putting in practice the conceptions of inventive power. The arts succeed each other by a true generation. Idea begets idea, and the invention of to-day gives birth to the invention of to-morrow. In the genial atmosphere of invention new industries take root in the old, like epiphytes in the humid forests of the tropics. Watch-making by machinery was established at Waltham, the cradle of the cotton manufacture in Massachusetts; and a still more luxurious art, the working of silver plate by machinery, was founded at Providence, the birthplace of the cotton manufacture of Rhode Island.

For a long time the mechanical arts reacted chiefly upon each other. The inventive and constructive power invoked by manufactures reached tardily, but at length, the fields of husbandry. The labor-saving machinery of the farm, the harvesters, reapers, mowers, and planters at the last two decades, came into existence. Agriculture, now doubled in its productive capacity, not by improvements properly its own, but through the auxiliary forces of the mechanical arts, presents the final and triumphant demonstration of the solidarity of the industries. This is the idea which called into existence your noble Institute, which inspires the grand expositions that distinguish the present age, and which you have made so obvious to our senses by placing the dahlia, the grape cluster, and the wheat sheaf by the side of the organ, the engine, and the loom, and by gathering all these fair products of labor under the self-supporting carpentry of this vast dome, which is thus an emblem of the unity of national industry.

IRON AND ITS MANUFACTURE.

An Address Delivered November 1st, 1870, By A. W. Humphreys, Esq., Treasurer of the Sterling Iron and Railway Company.

Introduction—Historical.

With the almost ceaseless hum of machinery in motion, which has justly been considered one of the great attractions of the fair now so successfully drawing to a close, still sounding in our ears, and nearly the whole of it made from iron, cast, or beaten, or twisted into forms of use and beauty, it is certainly quite unnecessary to expatiate on the importance of iron, or its constantly recurring and ever-increasing necessity in our daily life. The greater or less use of iron has well been pronounced a fair measure of the degree of the real civilization, and extent and variety of useful industry, which prevail in modern countries, and is, perhaps, the surest single means of readily judging of any people's position in the family of nations. The manufacture of iron was one of the earliest industries requiring joint or associated action, or the labor of several individuals to produce one specific end, the reduction of iron ores having begun very early, and being too difficult for one man to accomplish, to any extent, unaided; and its production quickly necessitated a more or less crude commerce, for nowhere does a family or tribe make its own iron without also producing a certain surplus to be bartered off to the less fortunate or less skillful; and this manufacture and barter, begun almost as soon as men ceased to live entirely by the chase, has continued constantly supporting or stimulating manufactures and commerce, until they have attained the stupenduous development of our own day, when every sea is blackened by the smoke of engines of iron steamers, and the wild beast is startled on every prairie and in every jungle by the shriek of the iron horse running on the iron rail.

For what uses iron has already become a universal convenience or necessity we all know, and the catalogue is too long to be even run through in a single afternoon; but after the wonderful strides of the past half century in the manufacture and consumption of this the really precious metal, what man so bold as to attempt a successful prophecy of its future utility: while it is almost as difficult to trace its early real history, stretching back into the dim twlight of man's existence, when shadows and realities are inextricably mingled. That Tubal Cain was one of the earliest workers in iron, is of course a familiar fact to every one who has read an article or heard a lecture upon iron, and its tolerably frequent use seems to have been familiar to many of the Bible writers. Og, King of Bashan, had an iron bedstead; chariots of iron, harrows, and other tools of iron, are spoken of, and a pen of iron conveyed a sufficiently familiar idea to make it a convenient figure for the Prophet Jeremiah; while the Israelites were early promised, as specially desirable, a land whose stones are iron. In Homer, both iron and steel are mentioned, and, in the 23d book of the Iliad, a mass of iron, only so large as a strong man might throw to some distance, is offered as a valuable prize at the funeral games of Patroclus; in the words of Bryant's spirited translation.

> " Again Pelides placed before the host
> A mass of iron, shapeless from the forge,
> Which once the strong Eëtion used to hurl,
> But swift Achilles, when he took his life,
> Brought it, with other booty, in his ships
> To Troas. Rising, he addressed the Greeks:
> 'Stand forth, whoever will contend for this,
> And if broad fields, and rich, be his, this mass
> Will last him many years. The man who tends
> His flocks, or guides his plow, need not be sent
> To town for iron; he will have it here.' "

At Babylon the huge stones of the bridges were held together by bands of iron, fixed in place by molten lead. Later, Thucydides tells us that the walls of Pireus were fastened in the same way. The Ninevites made tools of iron; and small objects of art made of iron, or iron and bronze, were found by Layard in tombs of early date. And through all the nations of high antiquity, iron is mentioned almost always in a way that shows it to have been a partially common, but always highly esteemed metal. Indeed, from the difficulty of working it with the primitive means at the command of men just emerged from barbarism, it was constantly held at a high price. Iron was exchanged for brass, weight for weight, and, whatever the age of the world, we find substanially the same fact at the same stage of a nation's developement; only 150 years ago, Botachoff, in Russia, having bartered iron for an equal weight of copper coin. So, also, in, the older ages, as now, those best skilled in the production and manipulation, of iron held a certain preëminece, and in some instances almost the only claim some of the smaller peoples have to a mention in the page of the historian, or which prolongs to our day that slight recollection, or indirect mention, which is their share of fame, has no title but their ability to wrest this metal from the tenacious grasp of combined impurities, and thus make it useful to themselves, and to their neighbors a coveted implement or dreaded weapon.

Thus the Chalybes, a once powerful Arminian race, famous fomerly for the quality of their iron, continue to celebrate their superior production and perpetuate their own memory by furnishing us the root of the word chalybeate. They, as other early iron-workers, left slight record of their processes or operations; Aristole indeed mentions that their arenaceous ores were washed, and he also partially describes the operation of making wootz in India; and Diodorus Siculus says that in the island of Ethalia, the ores were roasted, broken fine, perhaps partially reduced to blooms, and sold for iron-making; but these and other scanty particulars contain but little of instruction or warning for us. Slight knowledge we possess of the manufacture and treatment of iron in ancient India, China and Egypt, where there is plenty of evidence of its early use and importance, but only meager information as to the methods of obtaining it from the ores, and only deserves notice as showing how soon this metal began its influence and proved its importance. We are only sure that it was *wrought* iron that was produced and employed, and not *cast* iron, which is a comparatively recent production, and it is probable it was all obtained by a primitive direct process, from rich and easily reducible ores.

Down to the time of the Romans iron was too scarce and high to be of general use, but they employed it with comparative freedom; and perhaps in the absence of files of any scientific press, which now quickly promulgates any new discovery, and the progress made in the adoption of new materials, or fresh applications of old ones, nothing shows more succinctly the change which had taken place in the increased use of iron under that powerful race, than the fact that Homer speaks of death as a sleep of brass, while Virgil, with the same idea in his mind, conveys it familiarly to his public by calling it a sleep of iron. The Romans introduced the manufacture of iron to the Iberian peninsula, and Spain for a long time furnished not only metal to her neighbors, but also skilled workmen to those who wished to enter upon its manufacture for themselves; and probably France is indebted to Spain for what early knowledge of iron-working she possessed, while through France the practice passed on to Germany, and settling among the Hartz mountains, its numerous forge-fires helped furnish that extraordinary stock of goblin stories and fairy tales which were the delight and terror of our childhood. Further east and north, in Russia and Sweden, a knowledge of iron metallurgy probably came to them in a rude way from still farther east, where the hordes of Indiamen had long made the celebrated wootz, a steel of high quality, though made in the most primitive way, or perhaps from China, where iron and its magnetic properties have been known for ages. But at a later date all knowledge of the art of this manufacture as now practiced, came mainly from England, and therefore it is to her progress that we turn for the proper history of iron and its improved manufacture, as we know it. In Britain, it is extremely probable, but not certain, that the use of iron was known long before the invasion of Cæsar, though we are entirely ignorant of what may have been the method of its manufacture. With the occupation of the southern end of the island by the Romans, came quite extensive workings of the rich ores near the sea, and subsequently the Danes carried on the reduction of the same deposits of ores so largely, that at a still later date the piles of cinders left by them supplied many blast-furnaces, for a long time, with material for the production of pig-iron, the more perfect operation of the blast-furnace extracting iron from what was worthless slag to the crude operations of Romans and Danes.

EARLY METHODS.

The method employed by all the early workers of iron of whose operations we know anything, was similar to that still in use in India, in Borneo, in Madagascar, and in Africa, and consisted in heating as hot as a natural draft of air, or that artificially supplied by the crudest of bellows, would permit, rich ores of iron in contact with incandescent charcoal, and hammering the viscid mass until the earthly impurities were expelled and an irregular shaped lump of nearly pure iron remained, the "mass of iron, shapeless from the forge" of Homer, and which,still produced, by slight modifications of the same process, in numerous localities throughout the known world, we call a bloom of iron, from the old saxon word *bloma* the *bloma ferri* of the doomsday book, and which is hammered into bars or tools as wanted. This early manner of producing iron continued, with slight change, the universal method until the discovery of cast iron, and, together with its various modifications and offshoots, patented and unpatented, are all different branches as what is known as the direct process of making iron, being a production of malleable iron directly from the ore, at one process, in distinction to the now more common manner, called the indirect method, which first smelts the iron ore by means of the blast-furnace and then eliminates from the resultant pig-iron its carbon and other impurities, by puddling or other means until malleable or wrought-iron is obtained. That this indirect and roundabout way should be now generally adopted, seems almost paradoxical; and an inventor of one of the improved direct processes (for such inventors are numerous), being lead by an *ignis fatuus* to attempt the short cut across, instead of making the best of the road around, asks very pertinently, why convert iron already malleable (in the ore) into cast iron, to be reconverted, at much labor and cost, into malleable iron again? The question is an obvious one, and the only answer is, that thus far the indirect process has proved the most useful for the reduction of the majority of workable ores, in large quantity, all direct processes hitherto employed being applicable only to rich, selected, and easily reducible ores, wasteful of fuel, prodigal of labor, or irregular in their result. It is undoubtedly the dream of every iron smelter, who thinks much, or dreams at all, to find some method of obviating the use of the blast-furnace; but no commercially successful way has yet been found of realizing this dream on a large scale. That is still one of the not improbable achievements of the future.

The terms *wrought-iron* and *cast-iron* may occasionally lead to confusion and misunderstanding, and it should be constantly borne in mind that iron is iron, however and from whatever ores obtained. Wrought or malleable iron is nearly pure iron, and is malleable and ductile while cast-iron, as well as pig-iron, which is only a form of cast-iron, is a compound of iron and carbon, with some other impurities usually existing previously in the ore in too large, or too intimately combined quantity to have been entirely removed by the action of the blast furnace, and is neither malleable nor ductile. Malleable castings, of which keys, the ironwork about a horse's harness and many small articles are made, is cast-iron in which carbon was originally almost the only impurity, and which by a process of cementation has been so nearly removed as to make the castings slightly malleable, though destitute of fiber, which is developed in wrought-iron, but not at all ductile.

The Invention of the Blast-Furnace.

To properly trace the history of the present iron manutacture, we have only to go back about 500 years, to the development of the process of making pig-iron by the blast-furnace, at a date which cannot be fixed with precision, but about the beginning of the fifteenth century. It is probable that the gradually increased height of the little furnaces or forges, formerly in use, with the greater intensity of blast, also gradually increased, finally led to the complete melting of the ore, and so, by the final addition of some earthy flux, cast-iron was obtained ; but where and by whom the change was turned to any practical account is unknown, though the first furnaces erected to make only pig-iron seem to have been in France, or what is again, unfortunately, the debatable land between France and Germany ; and one of the earliest English makers of pig-iron imported a workman from France to teach him the art. But if France can claim the origin of the manufacture, England soon took and has since maintained the front rank in the quantity made, though to Sweden we still look for a superior quality of many descriptions of iron. The quantity of iron made in England was for a time seriously checked by want of fuel. Down to the beginning of the eighteenth century, charcoal had been the only fuel employed to any extent in the manufacture of iron, and the immense forests of Russia gave her, for a time after the manufacture was established, a certain advantage, and she sent large quantities of iron to England, where the drain of timber for iron-making had been so great, that in 1581 stringent laws were passed to prevent the consumption of timber in any new iron works within twenty-two miles of London , or fourteen miles of the Thames, such legislation being necessary to prevent a famine of fuel, the whole kingdom being then dependent on wood. This and some additional legislation having failed of its object, it was finally forbidden to use any timber for charcoal for making iron.

Some fuel was necessary, and the Dudleys spent much time and money in their experiments in the use of pit coal, finally succeeding in making iron by its use ; but, through various obstacles, many of them thrown in the way by jealous charcoal iron makers, not being able to establish it as a regularly accepted article.

For nearly eighty years after the final abandonment by Dudley of his persevering trials and partial successes, nothing was accomplished toward the practical solution of the problem, until finally, in 1735, Abraham Darby, of Colebrookdale, succeeded where so many others had failed, and the manufacture began a fresh period of prosperity, though still only partial, for the introduction of mineral coal necessitated further improvements, which the state of the mechanical arts made still impracticable, and England continued partially dependent on Sweden and Russia. In 1760 Smeaton erected, at the Carron works, the first large blowing cylinders, and these, furnishing the larger quantity of air necessary with pit coal, or rather the coke from pit coal—raw coal being yet unused—showed iron-masters in what direction lay the chief difficulty hitherto preventing the complete success which had been expected to follow Darby's discovery; while, at about the same time that Smeaton was constructing his large cylinders, Watt was improving the steam-engine, and he had so far perfected it, with the aid of Boulton, that in 1788 iron-masters were beginning generally to employ his double engine, which supplied the power necessary to work the large blowing-cylinders, thus completing what Darby had begun; but it extended no further than the blast-furnace and the manufacture of pig metal. Another step had been needed for the speedy and economical conversion of pigs into bars; this was supplied theoretically by a patent issued to Peter Onions, in 1783, in which the *rationale* of the puddling process was described and the principles involved fully covered. The next year Henry Cort of Gosport took out a patent covering the practical use of the puddling process, and the use of grooved rolls, and to Cort is generally ascribed the merit of both inventions; and he has been styled the Father of the Iron Trade; although, as a matter of fact, the mode of puddling described by neither Onions nor Cort is precisely followed at the present time. Cort spent a large sum in perfecting and introducing his inventions, and had what seemed the shrewdness to get a government official interested in his patent, and to furnish a part of the capital necessary, and Onions sunk out of sight. Cort's government friend was caught, however, in a defalcation or "irregularity," having in fact stolen the money he advanced to Cort. The government seized the patent; it was locked up in court, and Cort finally died a poor man, ruined by what has proved to be the means of wealth to England.

PROGRESS OF THE MANUFACTURE IN ENGLAND.

These improvements laid the foundation of England's supremacy as an iron producer; they speedily came into general use, and the production of iron, aided by the fostering care of the government and the unusually high price of foreign iron, rapidly increased. As the completion of these improvements, about 1790, was the commencement of the present era of iron making in England, it may be worth while to consider, for a moment, her previous and succeeding position in this industry, from a commercial point of view. The quantity of iron made in the kingdom nearly sufficed for the consumption of Great Britain until the passage of the stringent fuel laws above spoken of, and there were neither imports nor exports of any great quantity until the seventeenth century. Statistics of the whole product of the British Island previous to 1715 are not to be had; in that year there were estimated to be about 300 furnaces in operation, and the price of pig-iron was about £6 per ton; from the dearness of fuel and the operation of the laws against the employment of charcoal at iron-works, the production gradually fell off, until in 1740 there were only fifty-nine furnaces in operation, producing 17,350 tons per annum of pig-iron, while the net imports of iron of all descriptions, mainly from Russia, Sweden and the American colonies, were about 20,000 tons. Then came Darby's success with pit-coal, and the make immediately began to increase, and continued to do so moderately, until, in 1788, the total production of Great Britain was 68,300 tons, and her net imports about 15,000 tons. Then came Smeaton, and Watt, and Cort; the duty on bars was put at fifty-six shillings per ton, the value of bar-iron being about £18 per ton, and the manufacture fairly began the prosperity it has ever since retained, with occasionally a dull period of a year or more. In 1796, an additional duty of £1 per ton was laid upon bars, a rise of about thirty per cent took place in Russia, and the manufacture increased so fast that, to quote Tooke, "the produce of iron proceeded so rapidly, that, with the aid of further duties, amounting almost to a prohibition of importation, it not only kept pace with the increasing demand, but actually nearly superseded the use of foreign iron in this country, and furnished a surplus for exportation." In 1797, the production was 125,000 tons. So strong had been the stimulus, that in 1801, there were building or in blast, forty-seven new furnaces, 125 being then the total number of the old ones. Let it be borne in mind that no new process had been discovered since 1790, nor had any special improvements been made, meantime, in furnace machinery; the increase was due entirely to the increased demand, to a rise in foreign iron, caused mainly by this increased demand, and by the action of the government in so arranging the duties that Great Britain might herself reap the full benefit of the changed circumstances, carefully sustaining the feeble steps of this branch of industry while thus in its infancy. In 1806, the total number of furnaces in Great Britain was 173, making 258,000 tons per annum, an average of less than 1,500 tons to each furnace. In 1825, there were 364 furnaces, of which 261 were in blast, making 581,000 tons per annum. The duty at this time, on bar-iron, was £6 10s. per ton, having been gradually raised to this figure since 1796, and Great Britain, from being an importer, had so changed her relative position in the iron world, that her net exports were 90,000 tons.

THE USE OF HEATED AIR.

There was still no further change in modes of manufacture; but in 1828, Mr. J. B. Neilson, of Glasgow, took out his patent for the use of heated air, instead of the cold blast, which had alone, until then, been used to support internal combustion in the blast-furnace. Whatever merit we may gladly concede to the predecessors of Mr. Neilson for their improvements, it is certain that no single invention in the manufacture of pig-iron has been followed by so great benefits, or occasioned so marked advance as the use of the hot blast; although it deserves to be called a discovery rather than an invention, for, in the words of Dr. Percy, "there is no reason to believe that the patentee had, at first, any adequate conception of the value of his invention, and the great influence it was destined to exert upon the smelting of iron." But the iron masters were not slow to perceive the great advantages it offered, and promptly availed themselves of them, so that by 1835 it is said that the heated blast was in use at every furnace in the kingdom, with a single exception, and the quantity of coal necessary to smelt a ton of iron was reduced, in three years, from eight and 1-20 tons, coked, to two and one-fourth tons, used raw, actually consumed in the furnace, and 8 cwt. required to heat the blast, or a total of two tons 13 cwt. of raw coal, the Calder works having demonstrated, in 1831, the needlessness of coking when hot blast was employed, while later the expense of any extra fuel for heating the blast was dispensed with, the waste gases from the top of the furnace being used for that purpose. This latter improvement originated in France, where, in 1811, M. Aubulot took out a patent for their employment and utilization, reserving to himself, however, only their use as far as connected with his own business, the cementation of steel, giving to iron masters, with singular generosity, not only all the benefits they could derive in other ways from his patent, but carefully instructing such as chose to apply to him in the best way he know of collecting the gas, although he foresaw at least a part of the enormous advantages which would finally result from his idea. But little was actually done with the waste gases, however, to assist in smelting, until in 1845, Mr. Budd took out a patent in England for the utilization of the gases for heating the blast, and soon applied his principle, not only to the stoves, but to the generation of steam in the boilers at his furnaces, and since that time it is almost the universal practice to employ only the heat from the combustion of these gases for those purposes, and at some furnaces their employment is carried still further, and ore is calcined by them in kilns especially adapted for that purpose; though whether there is as yet any real economy in this, at large furnaces, remains, to a certain extent, an open question. The people of the United States have especial reason to hold Mr. Neilson in grateful remembrance, for, without hot blast it would be almost absolutely impossible to smelt iron with anthracite coal, the experiment of doing so with coal blast having been thoroughly and carefully but unsuccessfully tried in the United States, in France, and in Great Britain, the earliest recorded trials having been made as early as 1820, near Mauch Chunk, Pa., and next in France in 1827; but it was only when aided by hot blast that Mr. Crane, in Wales, with ovens built by Mr. Neilson himself, finally achieved success with this king of fuels, in 1837, though Geissenheimer had in 1833 taken out a patent in the United States for the use of anthracite, but with no practical results. Again, at Mauch Chunk, in August, 1838, this time with hot blast, and, it is asserted, without a knowledge of Mr. Crane's success, an attempt was made to employ the Pennsylvania anthracites, and a blast of five weeks is claimed to have been perfectly successful, the furnace being owned by Bauman, Guiteau & High. They stopped, from want of ore, in January, 1839, and, after somewhat enlarging the furnace, again blew in at the end of the following July, and continued in blast till November of the same year, having produced about two tons of iron per day, when working best, with a blast heated to about 400 degrees. The size of the furnace was five and one-half feet bosh by twenty-one and one-half feet high. The quantity of coal consumed per ton of iron made, I am unable to state.

The Pioneer furnace at Pottsville, was the next furnace successfully employing anthracite coal, and the same site is still occupied by an anthracite furnace owned by Messrs. Atkins Bros., though the old stack was torn down in 1853, and a larger furnace built on the same foundations. It was blown in by Benjamin Perry, with some general assistance from David Thomas, in July, 1839, and completed his first blast in January, 1840.

The above statements regarding the first use of anthracite seem to be well authenticated by documents written by the parties interested, at, and immediately after the dates mentioned above, and I believe may be relied on, though there has been some controversy upon whose brow should rest the *corona muralis* of success in this peaceful struggle, and I have taken corresponding pains to determine the conflicting claims.

THE USE OF ANTHRACITE COAL.

In a general way, it is sufficient to say that from 1839 dates the employment of anthracite coal for smelting iron in the United States, and the production of this description of iron has, with various ebb and flow, finally reached the handsome quantity of 971,000 tons made in 1869. The primal development of the use of anthracite we must concede to Mr. Crane, in Wales. The American iron-masters long ago left their Welsh competitors far behind in the production of this particular description of pig-iron, whether there be considered the quantity made, the size and general completeness of the furnaces, or the quality of metal produced, the generally poor character of the Welsh coal, and its excessive decrepitation upon the application of heat, having been powerful hindrances to the growth, at the place of its birth, of this particular branch of iron industry, Wales having made, in 1869, but 28,000 tons of anthracite pig-iron. With hot blast and the use of anthracite begins the real history of the extensive manufacture of iron in America. But this sketch would be quite incomplete and unsatisfactory without an attempt to follow, as accurately as possible, the progress of the early iron-workers on this continent, though the record is quite imperfect, our forefathers having had quite enough to do to maintain their individual footing, without giving themselves much anxiety about general statistics; and whoever traces carefully the fluctuating fortunes of the predecessors of the present iron-masters of this country will find that the soldier patriots of Valley Forge were not the only men whose faithful picket-duty in the cause of American independence was attended with immense personal sacrifice and heroic self-denial.

The red Indian knew nothing of iron extracted from the ore, but sometimes fashioned weapons out of ore as from any other rock. The first known iron-works in America were erected near Jamestown in Virginia, in 1615 or 1619, but after an unprofitable existence of only three years, the furnace was demolished by the Indians, and all the inhabitants of the surrounding village murdered, thus ending that initiatory enterprise. We hear no more of any very strong efforts toward the production of iron until, in 1644, forges were established at Lynn and Braintree, in Massachusetts, and, though only moderately successful, maintained their footing, and iron and its manufactures have never since ceased to form an important proportion of New England industry, nor to foster inventive skill, Joseph Jenks having, as early as 1655, by changing the form of the common scythe from the old English form, short, clumsy, and ineffective, into the tool we are familiar with, commenced the devolopment of that wonderful aptitude for improving the common utensils of life which we call Yankee genius, and of which the results are now found wherever the steel-trap has replaced the pitfall, the bow and arrow retired before the rifle, or the compact and economical cast-iron stove driven out the cold porcelain stove of the Germans, or the warm, but wasteful open coal fire of the English.

The small ponds in eastern Massachusetts and of Rhode Island for more than a century supplied an unknown number of furnaces and forges with bog ore, which, by the aid of charcoal from the then dense forests, was smelted into pigs, or forged into blooms, and, during this century, the manufacture of iron had been successfully established in most of the Colonies, from Massachusetts to Carolina, but no records worthy of credit now exist to state the definite extent of the total product. The exports of iron, beginning in 1717 with three tons, gradually increased until 1750, when 2,930 tons were exported. In that year the British Parliament removed the import duty on pig-iron made in the colonies, and on bar-iron being brought to London, but forbade the erection or maintenance of any mill for rolling or slitting iron, or any plating forge, the object being to get a new source of supply for raw irons at a time when the home-make had become insufficient to supply the demand, and at the same time prevent the colonies from producing iron further advanced than the pig, lest England should lose anything of her own importance as a manufacturing center. In 1756, a new law opened the other ports of Great Britain to colonial bar-iron and American exportation rapidly increased, though in a small way, the total in 1760 being 2,700 tons; in 1765, 4,342 tons, and in 1771, when it reached its maximum, 7,525 tons. The importations, meantime, had been small quantities of Russian and Swedish iron, say from 100 to 500 tons per year. Further than these scanty records of exports and imports, there exists no authentic information of the condition of the colonies, as a whole, prior to the revolution. With the outbreak of the war, exports naturally ceased, and the demand for war material not only taxed existing mills to the utmost, but caused a rapid extension of the industry, which was suddenly checked, and many individuals ruined, by the large quantities of foreign iron brought in as soon as the close of the war again opened our ports; England having in the mean time largely increased her facilities for manufacture.

The industry remained extremely depressed until the passage of the first tariff bill in 1789, the rates in which were raised in 1792, again in 1794, and the quantity of iron made steadily increased. In 1810 the United States contained 153 furnaces, making 53,908 tons of iron. From the lack of any compulsory returns of manufacture to the government, year by year, and the want only recently supplied, of any association among iron-masters, through which, for mutual advantage, such information could be obtained, there are but imperfect records of the quantities of pig-iron made in the United States. I will give all the figures for which any degree of correctness can be claimed down to 1850.

In 1810 we made	54,000	tons.
In 1828 “	130,000	“
In 1829 “	142,000	“
In 1830 “	165,000	“
In 1831 “	191,000	“
In 1832 “	200,000	“
In 1840 “	347,000	“
In 1842 “	215,000	“
In 1845 “	486,000	“
In 1846 “	765,000	“
In 1847 “	300,000	“
In 1850 “	564,000	“

In 1854 there were made 716,000 tons, and from then until the breaking out of the rebellion the yearly make was from 700,000 to 900,000 tons, varying slightly, increasing and decreasing year by year.

In 1863 the make was	947,000	tons.
In 1864 “	1,135,000	“
In 1865 “	931,582	“
In 1866 “	1,350,000	“
In 1867 “	1,461,000	“
In 1868 “	1,103,000	“
In 1869 “	1,916,000	“

England during these years had, of course, largely increased her production. In 1818 she made 300,000 tons, and gradually augmented this quantity until in 1835 it first reached 1,000,000 tons.

In 1840	1,500,000	tons.
In 1847	2,000,000	“

In 1850	2,500,000	tons.
In 1854	3,000,000	"
In 1856	3,500,000	"
In 1862	4,000,000	"
In 1863	4,500,000	"

And since then it has fluctuatingly increased to 4,900,000 tons in 1868, and about 5,400,000 tons in 1869.

THE GRADUAL DEVELOPMENT OF INDUSTRY.

For the sake of following the history of the commercial progress of our own manufacture of iron, I left the consideration of gradually evolved metallurgical improvements at the introduction of the hot blast and anthracite, from 1830 to 1840. We have seen that a century was occupied in making the five great steps which brought the metallurgy of iron from the comparatively primitive state in which Darby found it to the threshold of its development in America, namely: the use of mineral coal, of the steam engine, puddling and rolling, hot blast, and the use of anthracite.

The improvements since have been marked in their results; but there has been no one in the manufacture of pig metal which has given the trade any single great impetus; and of the several more or less famous which have facilitated the making of wrought-iron, of steel, of semi-steel, and of homogeneous iron, and their various compounds and shades of difference, I have not time to speak. Nothing less than a full afternoon could do them a moiety of justice.

In order to appreciate what has been done since 1840, let us glance at the then condition of the iron making process. The ore was charged, with its accompanying fuel, into the open tunnel head of furnaces of about twelve feet bosh and about forty-five feet high. Combustion of the fuel and reduction of the ore was effected by means of a blast of say 500 degrees, at a pressure of about three pounds. A part only of the waste gases were at all utilized by being taken from some distance below the top of the stack before they had become really "waste," frequently deranging the proper working of the furnace, while the portion thus taken was of but very little use, by reason of its insufficient mixture with atmospheric air and subsequent only partial combustion. The result was a consumption of a ton and a half to two tons and a half of fuel per ton of iron produced, and the quality of the metal made was decidedly variable, and the production per week about seventy tons. The pig-iron was then puddled entirely by hand to make wrought-iron, and the purified product rolled into merchant bars, not a rail having been rolled in the United States until 1843. Steel was only made by the old fashioned processes, either slowly, and at great cost, or, if more quickly, of variable and inferior quality. The lines of demarcation between the only three forms of iron then recognized, cast-iron, wrought-iron and steel, were strongly pronounced and definite.

It would be unfair not to mention the first use of the raw bituminous coal west of the Alleghanies, as the production of iron with this fuel will ultimately quite surpass in quantity that made with anthracite. David Himrod is said to have been the first to employ it, uncoked, in 1845, being driven by a strike of his workmen to either attempt this or blow out his furnace. He tried the raw coal, and with complete success, thereby opening the door to the manufacture in 1869 of 550,000 tons of iron made with bituminous coal.

Since 1840 the blast has been gradually made hotter and hotter, and the means of economically and regularly giving the air a temperature of 1,000 or more degrees have naturally attracted much attention, resulting in the patenting of various stoves, of which Player's and Cowper's plans may be considered leading methods of accomplishing this end, Player's operating by burning the gas from the furnace in a separate combustion chamber, below the pipes through which the cold air passes to be heated, and allowing only the heat to come in contact with these pipes, instead of permitting combustion to take place in the oven inclosing the pipes, as was the old plan, and the results have been very favorable, though it is fair to state that part of the gain from the use of Player's oven arises from the increased number and somewhat changed shape of the pipes themselves.

Cowper's patent, said to be a revival of an old Scotch idea, is but little known practically in this country, though favorably used in England, and is founded on the Siemen's regenerative principle, a cellular mass of brick-work being first raised to a high heat, and this heat then imparted to the blast, which is made to pass through it, while a similar mass of brick-work is being heated ready for use as soon as the first shall have become partially cooled. Whitwell's ovens, acting on the same principle, avoid some of the objections raised against Cowper's stove, the principal one being that it clogs readily with dust, and is expensive to clean. This Whitwell obviates, by making his brick-work into largish compartments instead of cellular. It is claimed that the blast can be heated to 1,800 degrees by this stove, and a regular working heat of 1,400 degrees be steadily maintained. To estimate properly the great importance of improved devices for heating the blast, it should be constantly remembered that for every ton of materials charged in at the tunnel-head, at least three tons weight of air is blown in at the bottom through the tuyeres; and it requires but little further consideration to impress on any one the great difference that must be exerted upon the work of the furnace if this air is put into the furnace already heated, or is introduced cold, and the work of heating it thrown upon the fuel in the furnace, which should find abundant employment in smelting the ore only. There is also an unexplained advantage in the use of heated blast, it being a fact that, if the air supplied to a common laboratory blow-pipe be heated to say 500 degrees, many substances previously infusible by the common blow-pipe flame are readily melted. Why, is yet unknown.

The complete closing of the tops of furnaces is another great improvement with most ores; and, as a rule, whenever a flame is visible at the tunnel-head, we may be sure that a large waste is taking place. The best device yet arranged is what is known as the bell and hopper, or cup and cone, which consists of an inverted truncated hollow cone of cast-iron, the cup or hopper filling the throat closely at the top, but considerably smaller at the lower end than at the throat. In this is suspended a cast-iron cone, by a chain attached to its apex, and so arranged to be raised or lowered at pleasure; its largest circumference being larger than the downward end of the cup, closes the top of the furnace completely, when raised against the cup, and, when lowered, leaves an opening of several inches all around it. Through this the furnace is charged, and as each charge passes through, it is immediately closed by raising the cone, and kept shut until time to admit another charge. The furnace gases, prevented by the tightly-closed cup from passing out of the furnace top, and collected in the open space around its lower end, pass out to the hot blast rooms, boilers and roasting kilns, through proper flues. The principal object of the closed top is that all the gases may be secured for use; but it has other incidental advantages, the cone distributing the raw materials much more evenly than practicable with simply a large hole in which to dump them, while the ability to close or open the throat assists in the general control of furnace action. An excellent English authority says that 600,000 tons of coal are saved in their Cleveland district alone, per annum, by the use of closed tops.

Passing at once from the top to the bottom of the furnace, we find an attempted improvement, not yet generally introduced, in Lurman's closed hearth. This plan builds up the hearth in a complete circle, leaving only a small hole at the bottom for the iron to run out, and, where the cinder notch usually is, a tuyere, one and one-half inches in diameter, is inserted, through which the slag runs off as fast as formed. The advantages claimed, and, in some places where this hearth is introduced, fully realized, are a hotter hearth, there being no heat wasted to keep up the temperature in the useless channel between the hearth and the dam; while the tuyeres, instead of blowing into the cinder, as is frequently the case, are inserted at a level of about nine inches above the slag outlet, so that the materials to be smelted have the full and uninterrupted effect of the blast; less time is required for casting, while the hearth is kept so hot as to have no tendency to "grow up," and, there being no fire-hearth, there is no crust to break up, thus saving much time; and, as the hearth has no opening through which the materials can blow out, a much higher pressure of blast may be maintained.

Quite in the region of theory, as yet, is the plan of Herr Schintz of Strasbourg, a metallurgist who has made the action of blast-furnaces a special study, and who has suggested innovations which have a plausible appearance of success. It is of course known that of all the atmospheric air blown into the furnace, whether hot or cold, a large proportion consists of nitrogen, which assists not at all in the combustion of fuel, and is of very doubtful utility, in any way, in the furnace, while it is certainly harmful in diluting the useful gases, and occupies a deal of space that could be much better employed, to say nothing of the fuel necessary for heating the nitrogen, along with the oxygen, in common air. Herr Schintz's theory has for its object the elimination of part of the great surplus of nitrogen by working the furnace partially with solid fuel, in the ordinary way, and partly with carbonic oxid, manufactured in separate generators and forced into the furnace through separate tuyeres with the ordinary blast. It is applicable, as far as developed, only to hot blast-furnaces, and the details are too long to find a place in this paper; but the plan is worthy the intelligent consideration of iron-masters, being theoretically correctly founded.

The Furnaces of To-day.

The size and shape of the furnace have gradually undergone great changes, the whole interior having been originally square in horizontal section, and the hearth was made square, or a parallelogram, long after the upper portion of the furnace became circular. When the interior was square, the exterior was naturally so, and was generally formed of stone masonry, heavy and massive, but the heavy masonry seems to have no special advantages beyond making a picturesque ruin when abandoned; and the later furnaces, in England and our own western States, are of what is called the cupola style, the heavy masses of stone at the corners having given place to simple iron columns, supporting a large iron ring, on which is built the stack; the exterior of the fire-brick, which forms the hearth, being open all around, and the stack itself consisting of the fire-brick lining with a course or two of red brick external to it, and surrounded by boiler plate securely riveted together, the whole looking not unlike a brewer's huge vat standing on four legs. The vertical section of the interior varies with the fuel and ores to be employed, and somewhat, also, according to local fashion; the precise shape, in any locality, is best attained by careful observation of the furnace, when blown out. The constant tendency of the best English practice has been to enlarge the hearth, and with beneficial results; though on the continent of Europe, generally, the small hearths are still adhered to. The throat has also been much enlarged from the size common thirty years ago, and the proportionate height of the furnace also increased, where the fuel is strong enough to bear it without danger of being crushed by the increased weight of the larger mass of ore, or the pieces of the crude materials so fine as to obstruct the blast, both which changes have unquestionably much increased the economy of fuel.

Now, then, after a lapse of thirty years, since 1840, a combination of the various changes and improvements gives furnaces of twenty-seven feet bosh and 105 feet high, a blast heated at will to 1,400 deg. Fah. blown with a pressure of from five to seven pounds per square inch, into the upper portion of a roomy, circular hearth, tightly closed except the absolutely necessary apertures to permit the egress of scoriæ and metal, and after supporting combustion, which must produce a heat of at least 3,000 degrees, and mingling with and partially forming the gases evolved, reaches the tunnel-head at a temperature of about 500 degrees, and there finding the throat entirely closed, is compelled to seek its exit through side flues, and do still further service, after being mixed with atmospheric air, in heating a fresh supply of air, or generating steam to force it, in its turn, through the same route; the result being a production at a single furnace of 700 tons per week, or from one stack, in 1870, more than double the quantity all Great Britain made in 1740, and made by the use of less than a ton of fuel per ton of iron.

The total quantity of pig-iron made in the United States in 1869, had a greater value, in this crude state, at average prices, than all the gold and silver produced in our country, by some $5,000,000. Throughout Europe, the advance in iron metallurgy has been scarcely less marked than here and in England.

	Tons.
In 1845, France produced	440,000
1869, France produced	1,380,000
1845, Germany produced	130,000
1869, Germany produced	1,220,000
1845, Belgium produced	150,000
1869, Belgium produced	863,000
1845, Austria produced	175,000
1869, Austria produced	395,000

The total quantity of iron made in the world in 1869, varied but little from 11,700,000 tons.

The changes in the various modes of manipulating pig-iron and advancing it to a finished article have been extraordinary and unexpected, and are still being made, or attempted with a rapidity which it is difficult to keep pace with, and to which I have not the time to refer, even by name, but must omit mentioning, as I have done many of the slight changes in blast-furnace operations.

For still greater improvements in making pig-iron, aside from great discoveries of new principles, especially in this country, where, I am sorry to say, even the advantages already gained are not as fully seized upon as might have been expected, we must look to a more general and thorough knowledge of the principles which govern furnace working, a more intelligent combination of various ores, so to use as little flux as possible simply as flux, making different ores perform that function for each other, or using a proper flux where a separate material is really necessary; to the use of fire-bricks made from materials best adapted to resist the corroding influences of the ores to be worked, and to a general practical recognition of the fact that the production of pig-iron is essentially a chemical operation, on a huge scale, where even slight variations from the really best way are productive of enormous waste. The above objects can only be attained by frequent careful analyses of all the materials employed, and then by carefully modifying their proportions in a scientific manner.

In the mechanical portion of the labor of smelting there needs also the most thorough economy, not however, always considering that an economy which is simply a neglect to do, in the preparation of the burden, from fear of the first cost, that which it really costs more to compel the furnace to do after the materials are charged in, such as roasting hard ores, thoroughly mixing ores, coal and flux, reducing the pieces of each to the sizes proper for speedy action upon each other, in the reduction zone of the furnace; also avoiding, as especially false economy, the hap-hazard way of charging, which is so frequent; for uniformity of action can only be secured by uniformity of means. I may perhaps be allowed to mention, as one excellent check upon this, the stock-house scales of Riehle Bros., which are on exhibition here, and which I know, from some years' use, to be extremely well adapted to that end. In our changeable climate, it may well be considered whether it is not also the best economy to protect, by non-conducting coverings, all pipes conveying steam or heated air, the loss by radiation being simply enormous, at many furnaces. Stock-heaps should be so arranged that the materials may be received and placed at the tunnel-head with as little handling as possible, bearing in mind constantly that pig-iron is nearly all labor, and that it should be reduced as much as possible, not necessarily by a decrease of the rewards of labor, so that our men may be compelled to live in squalid hovels, with scarcely the necessaries of life, and none of its comforts, or, as Mr. Wells has shown the Belgian workmen, with meat, cheese, tea, eggs, fruit, and artificial light of any kind so seldom employed as not altogether to form an item worth reckoning in the family expenses; nor need we aim at making the manufacture of iron exist, as a branch of national industry, upon the elementary condition of giving meat only once a week to its great mass of laborers, as Mr. Hewett so tersely sums up the substantial state of affairs in France. But we should observe carefully the steps already accomplished in cheapening the production of iron, or, what is synonymous, the careful utilization of the utmost power men are capable of exerting over crude materials, to make the labor performed by every workman employed of sensible effect in accomplishing the final result, and by carefully watching in what direction the observations already made and the principles already established are tending, see how they may be best made applicable to us and our country, that our magnificent natural resources may be made perfectly available, and the constantly increasing demand of our broad land be met from its own soil,and our own nation, instead of foreigners, permanently enriched by supplying it by the economical development of the treasures stored up beneath our feet.

What the Exhibition Shows.

What has been, and still is being accomplished in this direction, finds a partial barometer in this exhibition, a still more evident one in the rapid but wholesome growth of Troy, of Pittsburg, of Cleveland, and of the district about St. Louis; while, outside of towns, there is not a fertile farm in Pennsylvania which does not, by the high price put upon it, most powerfully indicate the advantages agricultural interests derive from the development of our mineral resources, and simultaneously point out the road Americans should wish to see America follow.

The statistics of the Lake Superior district will place vividly before you the most astonishing increase of the mineral development of our northern border within a little more than a decade of years, beginning with 1856, when iron ore was first mined there in any quantity, there were shipped 7,000 tons of ore, but not a ton of pig-iron was then made there. In 1869, 633,238 tons of ore were shipped over the two railroads leading from that region, and 39,000 tons of iron were made. During these thirteen years 3,000,000 tons of ore and 400,000 tons of pig-iron have been brought from what twenty years ago was practically a wilderness. Still further west the Northern Pacific Railroad will open up another region where a similar history will be repeated. Missouri has already begun her race in the same direction of industry. The whole tier of southern States only need complete restoration from the fever and delirium which began in 1861, and from which they are now convalescent, to pour out from their northern frontier such stores of mineral wealth as would make us gape with astonishment had not constant employment of that faculty made wonder at any display of material resources in the United States almost impossible.

The Manufacture of Rails.

Notwithstanding my determination not to go beyond pig-iron in treating my subject, I cannot forbear calling your attention to the surprising growth of our manufacture of rails, of which thirty years ago not a ton was made in America, the first rail having been rolled in 1843, while last year nearly 600,000 tons were made, more than half in Pennsylvania, and nearly 100,000 of it in New York, at Spuyten Duyvil, Troy, Rome, Syracuse, Elmira and Buffalo, of a quality admitted to be far superior to the foreign rails generally brought here, and with which we are compelled to compete in price. The quality of our pig-iron is better than three-fourths of that made in England; yet the question of quality is usually practically ignored when discussing the question of sustaining in America the production of iron in any form.

The total supply of iron ores of all desirable qualities is practically inexhaustible. The heaviest known deposits, taking the country through, are almost untouched. In many of the easily accessible locations, where the deposits, originally worked, have been mined so deep as to make the ores too expensive for profitable working, new beds have been opened in immediate contiguity, so that no loss has been sustained, and in others some accidental circumstance or systematic exploration has developed new deposits which could be so much more cheaply worked as to cause the abandonment of the old mine, while yet the ore was as abundant as ever. I have a familiar acquaintance with a property within two hours' ride of this city, which has been worked for more than a century, and which is so far from exhibiting signs of exhaustion as to have yielded last year, as cheaply as ever, more than 80,000 tons of ore. A striking example of long continued yield are the mines in the Island of Elba, from which ore has been exported for more than 2,000 years, and which yielded in 1867 60,000 tons of ore.

If the manufacture need not be limited from fear of exhausting ores and fuel, neither should there be any solicitude lest there be too much iron produced. The iron production of the world scarcely keeps pace with the augmented demand, and our country has never since its political independence was achieved made anything like the quantity necessary for its use, while the iron needed per capita is constantly increasing; so that to say that our make of iron is increasing faster than our population, and therefore it would perhaps be well to endeavor indirectly to check the growth of this industry, is most emphatically a fallacious course of argument. To compare very briefly our relative rate of consumption and production, let us glance for a moment at the metal required for rails, which absorbs the equivalent of half our make of pig-iron. Since 1866, when we first fairly got breath after the close of the war, the demand for rails for new roads has increased about ten per cent per annum. Estimating the duration of rails at ten years, which is certainly liberal, we have ten per cent more of the total quantity in use required every year for repairs, in all twenty per cent per annum. The American production of rails, in the same time, has increased thirteen per cent per annum, and in the make of pig-iron there has been an average increase of less than eleven per cent; showing that the supply of pig is constantly behind the increased demand from the rail mills, and the supply of rails constantly behind the increased demand from the railroads.

As a mercantile adventure, it would perhaps be unbecoming to me to say that it don't pay to engage in the manufacture of iron, nor should I wish to convey the idea that we may not, some time, hope to see our iron-masters experiencing that prosperity which has made some of the iron-workers in Europe the wealthiest men in their respective countries; but I hazard nothing in saying, that, except during the war, when every business paid extraordinary profits, if there be fairly considered, the capital employed, and the heavy risks necessarily taken, the production of pig-iron has never been largely profitable in the United States; and I desire here to say in reference to a statement, extensively copied by various newspapers, that a certain iron-work on the Hudson had paid forty per cent dividends; that, many years before 1861 it paid *no* dividends, and finally recently paid forty per cent, not on the capital actually employed, but, by the aid of its real estate, upon the original capital, which had lain a long time without yielding any return to those originally risking it. We may not hope for any sudden change from the generally very small profits furnaces are now making; but gradually, as labor becomes dearer in Europe, and capital cheaper here; as we, partially because of these changes lessening the risk of building large works, put up large furnaces, and are not compelled to adopt some inferior details of manufacture, because the best ones are, in the beginning, more costly; as we are able to command, and gain the habit of employing, the best scientific aids to our practical furnacemen; as, by experience, also, we learn the best way of employing our ores, not staying away from the water until we know how to swim, lest we be always dependent on the boat some one else may, or may not, be willing to spare us, but continuing our efforts to learn, though at the expense of occasionally going under the surface, we shall finally achieve the success which, as thorough Americans, no less than enthusiastic iron-masters, we aim at when we can profitably supply, not only the heaviest demands of the home market, but be enabled to reverse our present position, and export instead of importing this really precious metal.

CLOSING ADDRESS.

DELIVERED BY HON. HORACE GREELEY, NOVEMBER 5TH, 1870.

The American Institute closed its thirty-ninth annual exhibition on Saturday November, 5th. In the latter part of the afternoon, several hours were spent in announcing the premiums, after which Professor Benjamin Silliman of New Haven, Conn., was introduced, and proceeded to pronounce an enthusiastic and laudatory address, referring in general to the triumphs of American industry, and specifically to many of the articles on exhibition. At the conclusion of his remarks, Horace Greeley, president of the Institute, delivered the closing address, as follows:

HORACE GREELEY'S ADDRESS.

Ladies and Gentlemen.—When this congregation shall have dispersed, and when these lights shall have been put out, the thirty-ninth exhibition of the American Institute will have closed finally. We have been at work more than forty years; longer than the children of Israel wandered through the wildnerness. At first a little band, later a larger number, earnestly striving according to the best light afforded us, and with the help of all the means we could by frugality collect and retain, we have been trying to assist in the development and protection of American useful art and industry. I cannot say how far we have succeeded. I can only say that this institution, from the day of its foundation in the year 1829, up to the close of this exhibition, has labored with the single purpose of giving to American industrial art larger opportunities to claim the attention of our citizens, and the reward it is justly entitled to, and of commending that art and industry to the attention of the civilized world; for this American exhibition challenges European attention. The American Institute, by its fairs, by its publications, by its meetings, endeavors to give to this art, and to this industry, a recognition and a diffusion which they otherwise would not have received. We are not here to criticise; we are not here to disparage the labors of any kindred or of any diverse organization. There are some possibly older than ours; there may be others more effective than ours. All we can say is, that with whatever means the public has seen fit to endow us, with whatever talent it has pleased God to bestow on us, and with most earnest and resolute purpose, we have labored on in this cause. We began first to hold exhibitions in a single story of a building, perhaps fifty feet by 100, the old Masonic Hall, and found therein sufficient room for all we had; but now this great edifice, with all its annexes, is not large enough for our annual fair. We have extended our room and economized it in every way, and still we need more space, and space that we can command not only for a limited period, but at all times, throughout the whole circle of the year.

AN INSTITUTE PALACE OF INDUSTRY NEEDED.

Yes, fellow-citizens, it is important, it is vital, that there should be a perpetual exhibition in this city of the triumphant fruits of American genius and American skill. Our annual exhibition is held for a much longer term than it used to be, and you give us a generous, a persistent, a most emphatic patronage. We are thankful for all you have done for us; we are more thankful for all you have aided us to do for our country. But we say to you, that this wandering life of ours, like that of some Arab tribe, or of some Siberian nomadic company, is not what the American Institute needs and deserves. We have carefully economized dimes. We have laid up a little money even in the years when we held no exhibitions. We have been for years adding dollars to dollars, until now the accumulated fund of the American Institute is nearly a quarter of a million. (Applause.) We have done the best we could, but still these savings of forty years would not buy the ground we need; they would give us but a corner of a building if we had the ground. Still we have faith that the means will come, and that the time is not distant. You know we mean to hold, on the one hundredth anniversary of American Independence, on the fourth of July, 1876, an exhibition in this city of the products of the world's industry. We mean to challenge Europe to come here and show us what she has done better than we have done, to compare product with product, invention with invention, discovery with discovery, achievement with achievement, and to learn, if we may, wherein we are deficient, resolved to profit by our mistakes and shortcomings, and by the triumphs of others, and to make that a new point of departure for additional victories of American art. That is our purpose, such are our hopes, and we trust that before that day the needed edifice will have been built somewhere, and by some means, possibly by some rich man's help, possibly by an appeal to the thousands and tens of thousands of American mechanics, to contribute or to invest according to their means. One way or another we trust the great edifice, which shall be the home of a perpetual exhibition, will be ready for your occupation on the 4th of July, 1876.

ICE AND BEEF.

But, friends, I must say a few words on this exhibition, in addition to what Prof. Silliman has so forcibly and so lucidly laid before you. He has said some things of that great feature of our fair, the exhibition of the manufacture of ice, and its application here to what many will regard as rather a purpose of amusement than of practical and solid utility. But this is to judge it hastily and mistakenly. He has told you how this invention has grown up from small beginnings, until to-day you may make in an atmosphere of seventy-five degrees Fahrenheit a ton of solid ice for five dollars. Nor does this invention stop there. This day there are more than 3,000,000 cattle roaming over the prairies of Texas, which have been there produced without human labor, and which are sold there for less than one-third of their value in New York. If the means existed for slaughtering those cattle in Texas, and bringing the meat and hides fresh to this city in perfect condition for use, those cattle would be worth double what they are now, and we should be supplied with fresh beef in this city for fifty per cent less than we now pay for it. To this result this ice manufacture is probably to contribute. Instead of sending to this city herds of tortured, feverish cattle, such as are now brought here, the means are to be provided by science for bringing all this meat in less than half the bulk, and with two-thirds the power, to this city in perfect condition, to be dealt out and eaten by our people. Our beef is to come from Texas and from Colorado, where, a few days ago, from fields so brown and desolate, you would say no animal could possibly find grazing on them, I saw a train of cattle gathered up each day and sent on to feed the people of these eastern States. There will be ten trains a day, within a few years, coming from that region, and if we can but develop from this invention the means of bringing beef in perfect condition to be eaten, directly from those dry, high, airy plains—the best place in the world for slaughtering cattle—we shall double the value of the herds there and diminish the cost of feeding our people here.

Bedsteads, Fresco Paper and Heaters.

This ice machine is but one invention. There are others all around you. I call special attention to the various contrivances which you have seen on this floor for making all manner of elastic bedsteads of steel and wire and springs, for half the cost of the much inferior articles made ten years ago. There is in one part of this great edifice an invention whereby a properly stained or figured paper is applied to hard-finished walls, and afterward this paper is pulled off and thrown away, and you have those walls beautifully ornamented in colors which may be scrubbed and cleaned at any time and will remain bright and strong to the last. I could not value that invention too highly, for it is one that tends to make the poor man's home a hall of art at the very smallest cost.

So there are many other inventions around us which, if you have found time to examine them, you will see contribute directly to make the common life of the common people more comfortable, more graceful; as it were, to give it more poetry and sentiment, and all this at a minimum of cost. There is no other country where so many inventions for the economical creation and diffusion of heat are to be found as in ours; no other country where the rooms of the common people, the places they inhabit, are in winter made comfortable as ours are at a moderate cost. But I will not go into this subject, for I wish to say some words on a point which our friend who last addressed you has, doubtless for wise reasons, chosen in part to avoid; I mean the political economy which the American Institute has taught.

Protection our Doctrine.

This association is made up of men of all opinions, as it is of men of all pursuits and vocations. We have no creeds. We have never at any time proposed to establish any formula of belief as a basis of this Institute. And yet it has always happened, men say things happen, I mean to say it has always been the case, that this Institute has had for its officers, and the men who spoke its sentiments, Americans who strongly believed in the policy of protecting home industry. Call it chance, call it accident, we have been American mechanics, American artizans, American inventors or improvers in art; and because we were such we have sympathized, nay, we have shared, the convictions of that great class who at all times and in all parts of the country have believed it was wise and beneficent to protect our home industry, and to seek by protection to develop and diversify that industry, to build up new arts, to stimulate invention, to call into existence new factories, new furnaces, new forges, and every variety of industrial achievement, and institution, and device which contributes to this great work. Yes, we have as a body so felt, so spoke, so acted.

DOES PROTECTION PROTECT?

Is the question which an adversary proposes to ask and to discuss. That is to say, does fire burn? Does cold freeze? Will a duck swim? These are questions which speculators and theorists may ask, but which practical men never felt to be questions at all. I ask you to look in that part of the room where are the latest products of American skill in the fabrication of silk goods. Well, for fifty years this country had been trying to make silk goods, and had been forced to rest content with skein silk and twist; but since the year 1861, when our tariff was recast in the interest of protection, those goods have been made, and I point to them, as equal in substance, in excellence of fabric to any goods made anywhere on the face of this earth. They are possibly not exactly equal in gloss, in shimmer, in some meretricious qualities to the finest products of French art; but, sir, no nation on the face of this earth ever made such progress in nine years as this country has made since we returned to the policy of protection in the year 1861. Look at the goods, now largely sold, and ask yourselves whether you wish we were back where we were nine years ago.

THE ADVANTAGES OF AMERICAN IRON.

One gentlemen asks me: "What is the use of all this? Suppose we want a million tons of iron of various qualities and in different stages of perfection, and suppose we can buy that iron of Europe for a given sum of money; why should we be willing to pay more money to have that iron made in this country?" For two reasons; *First.* Because the more money does not cost us more labor and more products, *but the contrary!* "Why," said a good honest farmer in Connecticut, "I don't see why farmers should favor protection; it don't do them any good." And at the same time he went on and hired 100 acres of his land cleared of timber, and paid ten dollars an acre to have it done. But the next year we had a protective tariff, and an iron foundry was established in his neighborhood, and the founders began to make iron, and they came to the same farmer, and bought of him the timber on 200 acres, and paid him thirty dollars an acre for it. So this farmer, under protection, received thirty dollars for the same timber that under the opposite policy he was obliged to pay ten dollars to get rid of! Does any man fail to see that the additional value given to that timber was not merely for the farmer, but was for this whole country, so much added to our wealth by the protection policy, and so for millions more of acres? That value was created by building up a demand for timber in the neighborhood where it grew. You could not have drawn it fifty miles without destroying that value. It was only by bringing a market to it that its value could be created. When I found that I had on my land a large amount of the shrub known as laurel, sometimes called rhododendron, I began to inquire, since I wished to get rid of it, whether I could sell it for anything, and I found that there was a factory fifty miles away that would buy it for six dollars a cord; but as there was no factory near me, it was worth less than nothing. Every new factory gives a new value to the timber, to the rock, and to every inch of the soil in the township in which it is started.

Mechanical Skill a National Necessity.

The first reason, then, is that by making the iron, we give value to articles before worthless, and increase the value of articles before worth little. Everything bulky, produced by the farmer, is increased in value by having a factory near.

But, in the second place, when we make the iron instead of buying it, we gain not merely the iron, but the capacity of producing it, and it is of great value to know how to do things. Our southern friends found that out when they were involved in war and could not get even salt. Washington insisted that the experience of the revolutionary war had taught us that we must not depend on foreign nations for certain articles necessary to our well being and defense; and James Madison said, after the close of our second war with Great Britain, that we had to consider not merely whether articles were cheaper to-day abroad than at home, but whether they would be cheaper in case we were at war and our ports closed. We might save a penny in time of peace and thereby doom ourselves to pay an extra dollar in time of war.

The Senseless Cry of "Monopoly!"

The answer to all these arguments in favor of calling into existence new industries is "Monopoly! monopoly! monopoly!" Here are 500 iron factories. I want to make twice as many, and I take the direct means to produce that result. Is that monopoly? I desire to call into existence factories of steel, of brass, of cloth, of everything we need. I wish to have ten factories where there is now one, and my friend who opposes me says "Monopoly!"

Sometimes he says the prices are too high. Then I say to him, "Won't you make some of this iron, or cloth, or hardware, and lower the prices? Nobody on earth prevents you and 30,000,000 more from doing this very thing. Why won't you do it? I beg you to do it. I offer you every facility and inducement. Please go forward, then, and make it. If there is a dollar clear profit per ton you can certainly afford to do it. Go on, then, my free-trade friends. Pitch in! There is no monopoly that you are not a sharer in. Every American, and every man from the other side of the water partakes alike in this monopoly. No foreigner needs any naturalization even. He may go to work to-morrow, if he pleases."

Protection for American Workmen.

This coat I wear, you see it is not a very good one, was made in New York by a journeyman tailor, who got twelve dollars for making it, after it had been all cut and fitted and made ready for his needle. They tell me that just such coats are made in Europe for four dollars. Admitted, admitted! "Then," says a friend, "your interest is to get your coat made in Europe." No, it is not; it is not my interest. For to be able to buy coats at all, I must have purchasers for my newspapers, and those I cannot find in Europe, but I can find in America, if the workman is well paid and well fed. It is my interest that the American workman should be paid American wages, and live like an American freeman.

But my neighbor says, "No, better buy the European coat." I tell you there is no class among us to-day so well protected by the tariff as the poor seamtress in the garret. Take off this tariff and we should be flooded with European clothing, with the contents of all the slop-shops of Europe, cheap perhaps, but where would be the American tailor? Either he must make coats at European prices, or cease to make coats altogether. Suppose he ceases to make coats. At once he becomes a competitor with you or me in our vocations, for the man must live in some way. Of course he is an inferior workman at his new pursuit, and he must work for an inferior price. His labor gluts the market. Lower wages, throw other workmen out of employment, and so the circle widens, widens, widens till the whole community is distressed. Do you believe the corner grocer and the man in the tenement won't feel that? If the tailor works for European wages will he get his living cheaper? We are sending provisions to Europe and certainly he cannot get them cheaper here by reducing his wages. Still they say, "O, he'll get his living somehow, by hook or crook; he'll manage to live on his four dollars." Well, I hope those who are going to convince the workingman of that will have a good time doing it. They can do anything after they have accomplished that.

AMERICAN WAGES THE BEST IN THE WORLD.

But consider again. Here are men to-day coming from England, from Ireland, from Germany, from Canada, from all parts of the world, to get American wages and to learn American conditions of living. They have in Canada just the condition of things we are told we ought to have here. They have every thing as cheap as may be, and very low duties indeed, lower than we should require for revenue purposes alone. Why, then, do Canadians come here by tens and hundreds and thousands? Why but because they know by experience that they can buy things cheaper here with American wages than they can get them there with Canadian wages? They prefer the conditions of mechanical industry here to those existing abroad. I have only chosen to say what seemed to me necessary to show that while this Institute has no creed, and every free trader is welcome to join it at any time, I doubt not that it will continue to stand as it has stood, firmly on the side of American industry, diversified, fortified, established, maintained, by American legislation looking to American interests, and believing that by upholding and promoting those interests, it is subserving the cause of labor throughout the world. That legislation is giving us a stand-point wherefrom the laboring men look abroad upon the world and exhibits conditions of living which his brother in Europe and his brother in Canada regard with envy. And I trust that we shall continue so to fortify, so to maintain Americnn industry and American art, that they shall go on from triumph to triumph from this time until the end of material things.

THE FRUITS OF PROTECTION.

I do not anticipate the time when we can properly throw down all the barriers of protection. I say that crockery and china are not made here largely because we have never offered proper encouragement. Those arts have not demanded and received such protection as they deserved. I saw the other day a British artizan of the highest class who has come over to make plate glass. Why did he do that? Because we have of the best quality all the materials necessary for making it; and still more, because we have a duty on plate glass of sixty per cent. I hope he will be encouraged to go on, and I have no doubt that the manufacture of plate glass in this country will cheapen, and increase the use of that article very considerably and very speedily. Wherever American industry has gained a strong foothold and is well protected, there it sends out its products to the ends of the earth. At least it begins to do so. It is young yet. Some branches have attained maturity; others are attaining it; more will attain it. So let us go on, creating new industries and developing new arts, always under the ægis of American legislation, until this country shall be in art and industry what it is in government and society, the foremost country of the world.

SCIENTIFIC LECTURE—I.

THE STRUGGLES OF SCIENCE.

By George B. Loring, M. D., of Salem, Mass.

The first of a series of scientific lectures, under the auspices of the American Institute, was delivered Tuesday evening, December 20th, 1870, at the Academy of Music, by George B. Loring, M. D., of Salem, Mass., on the "Struggles of Science." Among those on the platform were Peter Cooper, President Barnard, of Columbia College, Prof. Tillman, Prof. Whitney and Gen. Cochrane. Nathan C. Ely, Esq., one of the Vice-Presidents of the Institute, presided, and briefly introduced the lecturer, who said:

Ladies and Gentlemen.—It would not be easy to find a more appropriate spot than this for the inauguration of a course of scientific lectures, intended, I doubt not, for the practical benefit of mankind. We are here upon the common ground of all nationalities, of all interests, of all religions, of all industries, of all speculations, of all experiments. New York, the great commercial emporium of America, is also the center around which has gathered the greatest diversity of society with all its wants and necessities, and tastes, and opportunities, united in the common purpose of developing every social and individual faculty, and of working out the problem of action; busy, vigorous, and almost desperate life. While every other locality brings forth its specific fruit, and sends out its representatives marked with characteristics easily recognized everywhere, and under all circumstances, New York seems to absorb everything and send forth everything, attaching all her family to herself by that mysterious influence which power and greatness always exert, and developing faculties adapted to every locality—a Parisian for Paris, an Englishman for London, a Bostonian for Boston, a Puritian for Plymouth; and always a New Yorker still. Twenty cities, twenty nationalities, twenty civil organizations, as it were, all in one; can you tell me the theory which is not explored, the thought which is not investigated, the science which is not applied to vitalize and develop this wonderful aggregation of human forces? From the time when Henry Hudson, fleeing from the ice of the polar seas, ran down to the great mouth of the Chesapeake bay, and, looking in, passed up to the highlands of Neversink, and at last cast anchor off Sandy Hook—now two hundred and sixty-one years—what various and intricate powers have been employed in developing this social and civil organization. For her commerce, astronomy has mapped out the heavens, and pointed out the pathways of the sea, realizing the hopes of Galileo as he pointed his telescope for the first time to the satellites of Jupiter, and establishing, as fixed laws, those "astronomical notions" which enabled Columbus to grope his way to the new world; and furnishing a guide to longitudes and distances which the most accurate and ingenious chronometer has, as yet, been unable to displace. For her trade all natural resources have been explored, and for her, within the last half century, in the language of Bayard Taylor, geography has determined all the principal features of our own vast interior regions; "the great fields of Central Asia have been traversed in various directions, from Bokhara and the Oxus to the Chinese wall; the half-known river systems of South America have been explored and surveyed; the icy continent around the southern pole has been discovered; the north-west passage, the *ignis fatuus* of nearly two centuries, is at last found; the Dead sea is stripped of its fabulous terrors; the course of the Niger is no longer a myth, and the sublime secret of the Nile is almost wrested from his keeping; the mountains of the moon, sought for through 2,000 years, have been beheld by a Caucasian eye; an English steamer has ascended the Chadda to the frontier of the great kingdom of Bornou; Eyre, Leichhardt and Sturt have penetrated the wilderness of Australia; the Russians have explored the frozen shores of northern Siberia, and descended from Irkutsk to the mouth of the Amoor; the antiquated walls of Chinese prejudice have been cracked, and are fast tumbling down; and the canvas screens which surrounded Japan have been cut by the sharp edge of American enterprise." Profound and accurate researches by mineralogists and geologists—Silliman and Hitchcock, and Dana, and Newberry, and Steary Hunt—have pointed out to her, where, in the midst of the mysterious fields of creation, lie the most valuable mineral and agricultural resources. Conceive, if you can, moreover, what modern chemistry has done for the smelting of ores, the preparation of chemicals, and mordants for dyeing; the development of the power of electricity and magnetism, the combination of metals most useful to the electrical engineer; the fixing of methods by which carbonic acid can be removed from crowded rooms; the exploration into the soluble and insoluble salts of soils and fertilizers, into life-giving and noxious gases; the preparation of medicinal and nutritious compounds in order to promote the health and comfort and luxury and intelligence and refinement of this city. Contemplate the elegant and substantial structures which challenge your admiration on every hand; traverse the streets and bridges, and the great iron highways, along which flows the tide of life incessantly back and forth, the systole and diastole from your heart to the remotest regions where your interests lie, and you may learn what architecture and civil engineering are doing for your grandeur and prosperity. In industrial mechanics and physics, there is constant effort and progress. In the work of sanitary regulations, to ward off disease, and in the therapeutics of common sense to cure it, the science of medicine has been brought to the highest standard; and the achievements of surgery, in removing deformity and restoring the bruised and broken frame, arise almost into the regions of the miraculous. The earth trembles, and the waters are vexed, with the application of all those forces which science has presented for the perfection of man's dominion and power over the material world. The victory of Fulton and Fitch and Watt and Arkwright and Stephenson is complete. And should science advance into that great region of thought and speculation, where faith is to be confirmed and unerring dogmas of public economy are to be proclaimed, I am sure the last step would then have been taken toward making this great and diverse municipality as perfect in its religion and politics as it now is in all the practical affairs of active and vigorous life.

THE SCIENTIFIC PERIOD.

But not here alone is this work going on. Everywhere in cultivated and civilized society may be found an intense and serious effort to infuse the accuracy of scientific investigation into all practical affairs, and into the broad foundations of the church and the State. Turn your eyes in any direction, and you will find the most powerful human intellect engaged in this labor. The scientific period has arrived. The profound and masterly minds of the age, Humboldt just now gone, Agassiz resting for an hour only, as we trust, to return with renewed vigor to his imperial career in the realms of science, and their great investigating fraternity on both continents, have placed science at last in the divine regions of human genius, once occupied by the poets, and historians, and orators, and philosophers, who so long enjoyed undisputed sway as masters of human thought. The prediction made by Dr. Young in the latter part of the last century, a prediction then, and a familiar reality now, has been more than fulfilled. Remembering, as he did, that "the last 200 years have done much more for the promotion of knowledge than the 2,000 years which preceded them," he says: "We have, therefore, the satisfaction of viewing the knowledge of nature not only in a state of advancement, but even advancing with increasing rapidity; and the universal diffusion of a taste for science appears to promise that, as the number of its cultivators increases, new facts will be continually discovered, and those which are already known will be better understood and more beneficially applied." And he adds a word, which I quote here for the encouragement of the American Institute in that career of usefulness which has thus far grown with its growth and strengthened with its strength, and which may not pause until its cheering influence is felt throughout the entire domain of practical science: "The Royal Institution," he says, "with other societies of a similar nature, will have the merit of assisting in the dissemination of knowledge and in the cultivation of a taste for its pursuit; and the advantages arising from the general introduction of philosophical studies, and from the adoption of the practical improvements depending on them, will amply repay the labors of those who have been active in the establishment and support of associations so truly laudable." Not, however, in the two centuries preceding this declaration, nor in the half century preceding, but in the short and eventful period which has followed, have the great achievements been made. The brilliant career of Buffon had just closed; but Laplace, and Cuvier, and Davy, still lived, and made promise of that wonderful march of science, which rose before the mind of Dr. Young, who might now be lost in admiration, before the imposing monument erected upon the foundations laid by his distinguished cotemporaries. For, now, it would not be the labors of the great alone which he would be called upon to admire, but that "deliberate and concurring judgment of common minds," as Lord Bacon calls it, which has made science familiar to us all, and has filled the highways and by-ways of society with its life giving fruits, and the human mind with its invigorating modes of thought.

Religious Persecution of Science.

And, now, surrounded as we are by all the blessings which science can bestow, and by all the promises which its enthusiasm can make, we cannot and should not forget the severe and desperate struggles it has been obliged to make in its upward progress. The cruel agony and torture which have visited the religious reformer; the poverty, and contempt, and despair which have made death welcome to so many of the sons of genius, whose immortality is now man's great inheritance; the hard and unequal warfare maintained by those who have fought for human freedom and equality and right are familiar to us all. But not one such trial alone, but all and more have fallen upon and harassed and persecuted those who have endeavored by scientific research to ameliorate the condition of mankind, and to "look through nature up to nature's God." It is indeed difficult for us to realize, that against the theory, that the earth is a terraqueous sphere, the whole power of the Christian church should have armed itself, as late as the sixth century, and that nothing but the fact of circumnavigation, centuries later, dispersed the ecclesiastical forces. We turn with shame from the ignominy heaped upon Copernicus while living, and the insults to his ashes when dead; from the imprisonment, and torture, and fiery death, of Bruno; because they proclaimed the great scientific fact that the earth and planets revolve about the sun. Our hearts are moved with indignation and sorrow as we behold Galileo, driven from the pale of Christianity, denounced, tormented, forced in his old age to "abjure, curse, and detest the error and heresy of the movement of the earth," because he had worn out his great life in studying the glories of the heavens which God had made, and had taught the world that in obedience to the divine harmony, which set the constellations in their places, the earth did move, with its starry companions, around a common center. We can hardly believe that the first great anatomist was exiled by the lovers of "sound learning," in one of the most enlightened and pious courts of Europe; and we hasten to forget that in our own day, in the name of religion, the best geologists, men of exemplary lives and an abiding faith, have been denounced as infidels and atheists, for having opened that volume on whose stony pages are written the succeeding chapters of creation and the great laws of an all-wise Creator.

The Fallacies of Philosophy.

But this severe struggle between science and religious dogmatism, that strong fortress, behind whose frowning bastions the most fervid religious faith is prone to seek shelter and protection, is small when compared with the long and bitter contest which attended its emancipation from the tyranny of intellectual arrogance and pride. Contrary to that modern theory of science which would dispense, with a large and liberal hand, the bounties of sound learning to all men, "for the relief of man's estate," the ancient philosophers assumed that the object of all learning was to elevate man above this sublunary sphere, and to fill his mind with a lofty indifference to all his wants, and necessities, and comforts. "Philosophy," said Seneca, in reply to Posidonious, who inadvertently complimented science for having discovered the principles of the arch and the proper use of metals in the arts: "Philosophy teaches us to be independent of all material substances, of all mechanical contrivances. The wise man lives according to nature. Instead of attempting to add to the physical comforts of his species, he regrets that he was not cast in that golden age when the human race had no protection against the cold but the skins of wild beasts, no screen from the sun but a cavern. To impute to such a man any share in the invention or improvement of a plow, a ship, or a mill, is an insult. In my own time there have been inventions of this sort, transparent windows, tubes for diffusing warmth equally through all parts of a building, short-hand, which has been carried to such perfection that a writer can keep pace with the most rapid speaker. But the inventing of such things is druggery for the lowest slaves; philosophy lies deeper. It is not her office to teach men how to use their hands. The object of her lessons is to form the soul: *Non est, inquam, instrumentorum ad usus necessarios opifex.*" "We shall next be told," exclaimed he, "that the first shoemaker was a philosopher." It has been well said that in the minds of such men as he, "the business of a philosopher was to declaim in praise of poverty with two millions sterling out at usury; to meditate epigrammatic conceits about the evils of luxury, in gardens which moved the envy of sovereigns; to rant about liberty, while fawning on the insolent and pampered freedmen of a tyrant; to celebrate the divine beauty of virtue with the same pen which had just before written a defense of the murder of a mother by a son." But it was this style of thought and speculation which occupied the attention of the world for more than 2,000 years. Socrates, Aristotle, Plato, Seneca, Cicero, all lived in an atmosphere of intellectual superiority, which enabled them to transmit to the student all the sublimity of thought of which finite man is capable, all the moral elevation which the human heart can reach, all the religious confidence and trust which man can attain, unaided by the light of revelation. It is not surprising that through so many ages they should have exercised supreme sovereignty in the kingdom of thought, and that great minds should have followed them and little minds have been obedient to them. Nor, perhaps, is this a misfortune. For it were not easy to tell the intellectual effort which they have inspired, nor to count the scholars they have created, nor to value too highly the assurance which they have given to mankind that the monuments of genius shall not decay, even though material grandeur shall perish and be buried beneath accumulating dust. We are willing to walk hand in hand with them through those long ages, in the darkness of which their lights were not extinguished, and in the radiance of which it was their scholarship which prevailed. But we can imagine how our obligations to them would have been increased, had they and their followers substituted for wearying disputations, an encouraging word for natural philosophy as the foundation of useful discoveries, and not as a subject for fresh controversy, and mere mental exercise. Nature and the generations of men can afford, I have no doubt, to wait for light; but still the hours are weary, and I know no story in all the history of man's intellectual endeavor sadder than that of the one great scientist of the middle ages, who, blinded by the luster of scholasticism, and bound hand and foot by the rigors of ecclesiasticism struggled in vain to emancipate practical science, and left behind him his own hints as a guide, and his own failure as a warning to his great namesake, who, coming after him, fell on more fortunate times. We are told that when Roger Bacon, in 1234, studied mathematics, physics, and astronomy, and impoverished himself and his friends in purchasing the most costly instruments of his times, experimental philosophy was little in vogue and his researches excited the hostility of his fellows. He was a devoted student of Aristotle and all his commentators in every language; but he found it impossible to carry the teachings of this great philosopher into practical science, at a time when all science was considered no better than heresy, and its results no better than magic. His writings were condemned; in his old age he was imprisoned, and he died in neglect. He was the great anticipator of science, and the scientific age, which dawned upon the world three centuries after his death. He conceived the discovery of the telescope, and knew the composition of gunpowder, but was not permitted to witness the glorious revelations of the one, nor the inestimable force of the other. With his mind filled with visions of scientific grandeur, he could get but little further than to declare that the causes of the intellectual torpor and ignorance of the era in which he lived, were, too much blind confidence in authority; too much respect for custom, too much regard for popular prejudice, and too much conceited selfishness, which induces one to regard as dangerous and puerile whatever he does not know. But he "claimed for human reason the right to exercise a severe control over all the doctrines submitted to its approbation; he insists upon the dignity and the importance of the sciences, none of which are to be proscribed, and all of which are to be cultivated; and he establishes experience rather than reasoning as the proper method of research." And so this great man surrendered, leaving behind him only his appeal for intellectual progress, and preparing the way for a more defiant and revolutionary age of great discoveries, and popular assertion, and religious reform, and emancipated science. Three centuries passed away before his prophesies were fulfilled.

The Baconian Era.

And now the great struggle commenced. Men still believed with Plato that science was a mere intellectual exercise and amusement; that the study of arithmetic was not intended for any practical service in life, but to habituate the mind, to the contemplation of pure truth; that mathematics, applied to any purpose of vulgar utility, became a low craft, as he called it, fit only for carpenters and wheelwrights, and was no longer a noble science "leading men to the knowledge of abstract, essential, eternal truth; that the use of astronomy is not to add to the vulgar comforts of life, but to assist in raising the mind to the contemplation of things which are to be perceived by the pure intellect alone;" that the science of medicine should be applied only to those whose constitutions are good, and not to those who by inheritance, or excess, or exposure, or accident, have become so permanently enfeebled that their heads grow giddy and full when exerted in the studious contemplation of divine philosophy, the remedy for feeble constitutions being death. That the science of legislation was based upon abstract virtue, and not upon that practical wisdom which would prevent and reform crime, and build up a state upon the principles of patriotism, and honesty, and courage, and honor, and furnish the highest faculties of man an opportunity to exert themselves "without being molested or insulted for it," as General Grant said in his memorable conversation with Judge Hoar.

But this was not enough to satisfy the mind of Francis Bacon, who now assumed the leadership of the great scientific revolution begun by him and carried out in our day by the devotees of science everywhere. Entertaining profound respect and admiration for the great thinkers of ancient times, to whom I have alluded, and moving by his own natural forces along the same high plane of thought which they occupied, he stooped down and lifted into their august presence that useful and manly, and homely attribute, known as common sense. To be a philosopher meant with him to be the most useful man in the world; and so to him belongs the praise of having invented, methodized, and in a considerable degree perfected, the general plan for the improvement of natural science by the only sure method of experiment. "Instead of hypotheses he asked for facts, gathered laboriously from the watch of nature's silent revolutions, or extorted skillfully by instruments and trials, and carried forward by careful generalizations from the world of the known to the unknown." He reasoned always from causes to effects, and so impatient was his mind of mere abstractions, that he never rested until he had brought his conclusions to some practical benefit. "He clearly, for instance, conceived of a thermometer; he instituted ingenious experiments on the compressibility of bodies, and of the density and weight of air; he suggests chemical processes; he suspected the law of universal attraction, afterward demonstrated by Newton; he foresaw the true application of the tides, and the cause of colors, which he ascribes to the manner in which bodies, owing to their different texture, reflect the rays of light." Ask a follower of Bacon, we are told what the new philosophy, as it was called in the time of Charles II., has effected for mankind, and his answer is ready: "It has lengthened life; it has mitigated pain; it has extinguished diseases; it has increased the fertility of the soil; it has given new securities to the mariner; it has furnished new arms to the warrior; it has spanned great rivers and estuaries with bridges of form unknown to our fathers; it has guided the thunderbolt innocuously from heaven to earth; it has lighted up the night with the splendor of the day; it has extended the range of human vision; it has multiplied the power of the human muscle; it has accelerated motion; it has annihilated distance; it has facilitated intercourse, correspondence, all friendly offices, all dispatch of business; it has enabled man to descend to the depths of the sea, to soar into the air, to penetrate securely into the noxious recesses of the earth, to traverse the land in cars which whirl along without horses, and the ocean in ships which sail against the wind. These are but a part of its fruits, and of its first fruits. For it is a philosophy which never rests, which has never attained it, which is never perfect. Its law is progress. A point which yesterday was invisible is its goal to-day, and will be its starting point to-morrow."

THE FRUITS OF INDUCTIVE REASONING.

I have said that Lord Bacon endeavored to found his theory of philosophy on common sense; I think he established the process by which he could reach the highest philosophical truth, upon the principles of common honesty. He proposed no new method of reasoning. The danger and weakness of syllogism were discovered long before he was born; the value of induction had been recognized by scholastic and scientist for centuries. But Bacon realized that a process of induction which failed to recognize all existing and possible facts, whether by accident or design, is as fatal to truth and sound philosophy as a syllogism which, unmindful of the fallacy of accidents, proves that we eat raw meat: "We buy raw meat in the market; what we buy in the market we eat; therefore we eat raw meat." He knew well that the inventor and discoverer who would arrive at any conclusion valuable to himself and mankind, or the scientific explorer who would open new paths to useful knowledge, could not afford to shut his eyes to any facts or phenomena connected with the work upon which he was engaged. He felt that the recognition of error and failure is as impor[illegible]nt in all investigation as the recognition of truth. He turned [illegible]ess of induction, therefore, from the scholastic business of m[illegible] good syllogism, perhaps of no value whatever, to the philoso[illegible]iness of making a great discovery, or arriving at a great trut[illegible]le to millions of the sons of men toiling to elevate themselve[illegible] the highest regions of civilization, with all their mortal necess[illegible]ir immortal aspirations. He was as impatient of fallacy [illegible] an accumulation of facts from which no principles could [illegible] And so he threw aside the books of the ancient schoo[illegible] they taught nothing for the discovery of useful trut[illegible]t the books of the ancient farmers because they laid [illegible] and could therefore be of no use to any man. [illegible] have rejoiced in Franklin, who caught, and M[illegible] lightning; in Brancas, who discovered the po[illegible] Watt and Fulton, who applied it; in James [illegible] who invented tile-drainage, and in John Jo[illegible], who has employed it in a successful warfare [illegible]ood and the wheat midge; in Count Rumford [illegible] profound study of the theory [illegible] fire-places, and grates, and

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ovens and cooking-ranges, and founded a professorship of the application of science to the art of living; of Agassiz, who, having studied botany with Martius, and the embryonic development of animals, with Dollinger, and the principles of classification with Oken, and zoology with Cuvier; joined hands with the farmers of Massachusetts in their investigations of soils and crops and animals, and taught the fish commissioners of Massachusetts how to stock the lakes and rivers of that industrious and enterprising commonwealth. What an admirable professor in a school of technology Bacon would have made; what an efficient and accomplished president of a model agricultural college.

THE EMANCIPATION OF SCIENCE.

When Lord Bacon introduced the demands of common sense and the principles of common honesty into philosophical reasoning and investigation, when the student of nature adopted the motto of "Nullius in verba," and listened only to the results of experiments, or to the unerring mathematical deductions from those results, then the temple of science was raised with rapidity and triumph, by the accumulation of facts upon facts, which were firmly cemented by the strictest reasoning. And then the emancipation of science was achieved, and that struggle began which in various forms has continued to this day. And what an era of emancipation was that in which Bacon wrought. Everywhere the bonds which had bound man's soul seemed to be breaking. Between the birth and death of Bacon, America opened her arms to receive the oppressed and persecuted. The Huguenots brought their protesting faith to our southern shores. The Puritans, who had kindled and preserved the "precious spark of liberty" in England, having sought shelter in vain in the Old World, braved the dangers of an almost unknown sea, defying with their fervid hearts the freezing storms of winter and the still more freezing storms of man's bigotry and persecution, and planted popular right and independent Christian worship in the new world, making sacred this very night on which we have assembled, the 215th anniversary of the last solemn hour spent by that weary band before they landed at Plymouth and gave an immortal soul to the empire of human equality on this continent. In the world of thought, Shakespeare performed his divine and undying work. In the world of science, Harvey discovered the circulation of the blood; Drebel invented the thermometer; Torricelli invented the barometer; and Kepler erected as a monument to his genius the "Astronomia nova celestis." It was the era of mental and moral protests and assertions, from which our own great privileges and opportunities have sprung.

From that period, the struggle which science has so long carried on against bigotry and intellectual arrogance has been conducted with a spirit of "audacity and sobriety" worthy of its great master, against the natural obstacles which lie in the way of finite man, in his endeavors to comprehend and employ the works of infinite wisdom. Once free. Science has not been disheartened in her career of usefulness and honor. What an army of martyrs does she already present for the respect and admiration of mankind! Amid the eternal snows of mountain heights, in the awful solitudes that surround the poles; in the smothering damps of unfathomed mines, scorched and stricken down on the burning sands of the desert, poisoned by miasmas, stifled by the fatal gases of the laboratory, wasted by long toil over the intricate and wonderful structure of the human body, the sons of science have bravely and nobly perished, that man might be brought into more intimate relations with that creation of which he has been made lord and master. Clothed now with the heroism and self-sacrifice which ennoble every great and good cause in which man can engage, science goes on from achievement to achievement, and will continue to go on until she reaches that boundary which is drawn between the human and the divine, and beyond which we "walk by faith and not by sight."

SCIENCE VERSUS DISEASE.

That this path lies before her, who can doubt? In the material world which lies all around us, in the earth on which we tread, and from which we draw our very existence, are constantly recurring phenomena, which have thus far seemed to defy all human ingenuity to comprehend or control. But one by one they are explored, until what before was dark seems illuminated by a radiance almost divine. To all of us, for instance, has been brought home the sad and sudden and distressing calamity; "the terror which walketh in darkness, and the destruction which wasteth at noonday." Stricken homes and wasted fields are too familiar to all men. And man seems to have been powerless, thus far, in anticipating or preventing the ravages of of contagious diseases, and epidemics, or of destroying the swarms of destructive insects which invade his crops. And now Mr. Huxley steps forward and declares: "It is at present a well-established fact that certain diseases, both of plants and of animals, which have all the characters of contagious and infectious epidemics, are caused by minute organisms. The smut of wheat is a well-known instance of such a disease, and it cannot be doubted that the grape-disease and the potato disease fall under the same category. Among animals, insects are wonderfully liable to the ravages of contagious and infectious diseases caused by microscopic fungi." Now, rejecting entirely the idea that Mr. Huxley could even "expect to be a witness of the evolution of living protoplasm from the not living matter," and accepting the theory that the origin of pestiferous particles, even, "is to be accounted for by the ordinary process of the generation of like from like," may we not believe with him that the nature and cause of many a scourge will be one day as thoroughly understood, "as is now the microscopic organism of Pebrine, and that the long-suffered massacre of our innocents will come to an end?"

It is, indeed, a consolation to us to know that microscopic investigation has revealed the fact that many contagious diseases, which have been more destructive than war or famine, "are dependent for their existence and their propagation upon extremely small living, solid particles," which, if they are parasites, may be stamped out by destroying their germs." The destruction of these germs for the prevention of contagious diseases among men and domestic animals, and the employment of parasitic germs for the destruction of insects injurious to vegetation, present to the practical scientist vast opportunities for useful exploration, and for actual service to mankind, which would be forever held in grateful remembrance. It is in such service as this that science has achieved one of her most brilliant modern victories, for an account of which we are indebted to Mr. Huxley in his fascinating essay on the "Origin of Life." A peculiar epizoötic disease attacked the silk-worms in France about the year 1853, and threatened to destroy the great silk producing industry of that country, involving a loss of thirty millions sterling to the silk-grower, and overwhelming with poverty and distress a vast population employed in the most important manufacturing towns. After many unsuccessful investigations into the cause of this disease, M. Pasteur commenced a scientific exploration which determined the cause and provided the remedy also, and in the performance of which Pasteur added his name to the long list of those who have sacrificed themselves for the benefit of mankind. He discovered that this devastating disease "is the effect of the growth and multiplication of the Panhistophyton in the silk-worm;" that it is contagious and infectious, because the corpuscles of the Panhistophyton pass away from the bodies of the diseased caterpillars, directly or indirectly, to the alimentary canal of healthy silk-worms in their neighborhood; that it is hereditary because the corpuscles enter into the eggs while they are being formed, and consequently are carried with them when they are being laid; that it is an independent organism, which is no more generated by the silk-worm than the mistletoe is generated by the oak, or the apple-tree on which it grows, though it may need the silk-worm for its development, in the same way as the mistletoe needs the tree." "Guided by this theory, he devised a method of extirpating the disease, which has proved to be completely successful whenever it has been carried out."

SCIENCE IN AGRICULTURE.

Encouraged by this success of M. Pasteur, what may not the agriculturist expect from that alliance between himself and science which has been established during the last quarter of a century. Not that science will ever enable the farmer to shut his eyes to those great influences of nature, which the hand of man cannot reach, which no investigation can fathom, no human power guide; not that it will enable us to control the skies and the seasons; not that it will ever invade that unexplored region, where lie the strange forces which we all, philosopher and farmer alike, admire, obey and leave with the good God who made them. But that we may discover and remove the causes of disease in our soils and our animals; that we may make war upon the insects which ravage our fields and orchards, with some more potent agency than our hands and implements; that we may rescue our crops from those maladies which seem to put a limit to their very existence on the earth; and that both visible and microscopic organisms will one day be destroyed by antagonistic organisms controlled by man. That this is expecting too much from science I cannot for a moment believe, supported as she may be by an accumulation of appropriate facts and guided by accurate experiments.

SOCIAL SCIENCE IN AMERICA.

And now I turn for a moment with the deepest interest and the most profound respect to that struggle which science is making to enter the great domain of social and civil economy, and to establish fixed laws by which society and the State may be guided and elevated. Met, as she is, on the very boundary of this domain by every variety of human taste and necessity, by a great diversity of social and civil organization, by all the various opportunities and obligations which attend the geographical divisions, the mountains and plains, and seacoasts and islands, by a thousand industries new and old, and by all the established systems of society and State, every one of which virtue irradiates and vice deforms, her task becomes at once difficult, her temptations great, her dangers imminent. If there is any field in which she is to exercise the soberest judgment, it is here. If there is any investigation in which facts are to be collected, arranged and weighed, it is where the prosperity, and happiness, and elevation of the human race are concerned. The soundest political philosopher is he who, gathering together all those causes of prosperity, general, diffused, and attended by popular virtue, which history provides, accepts the lesson which they teach, and promulgates the laws which they indicate; not he who starts with his theories and lends to them his facts. That virtue and mortality attend general prosperity, no one can deny; that vice waits upon poverty and idleness is too true and too sad; and recorded facts may teach us what has developed the one and in consequence suppressed the other. If the record of executive power here or elsewhere points to encroaching dictation; if the history of legislative actions is nothing more than the annals of corruption; if the chapter of civil service is black with incompetency and dishonesty, it is indeed time that political science should organize a State more worthy of a free and enlightened people. If under any system the capital of our country has been scattered, and the labor of our country has been beggared and oppressed, let political science proclaim its reform at once. But let us at any rate look at things as they are. For once I accept American facts as the foundation of American theories of public policy. A century of American nationality has its useful and encouraging lesson, of which we all may be proud, and from which we cannot turn in hopes of being taught a better. We have arrived at a system of government in which human equality is recognized, and in which industry, intelligence and morality are considered the attributes of good citizenship. We have reached a degree of prosperity, and wealth, and social comfort, and elasticity, and vigor, in which all may share, unknown in all its characteristics elsewhere on the face of the earth. Making this a standard of political science, I am ready to accept it, both as a guide for the future and as the law of American nationality laid down by the fathers, who believed in American citizenship as an opportunity for human development, and in American industry as the vital force of our own country, an example for others to follow, and in no way to be guided and controlled by inferior, and, as we think, less humane systems. We have learned much by our own experience as a nation, more than by the experience of others. Let this, then, be the foundation of American political science.

To that scientific thought, which never tires in its explorations, and which may find its problems in every sphere in life, we submit our material welfare, relying upon the wisdom and integrity which now lie at the foundation of all its true success. And wherever the fraternity of philosophers inspired by this thought may turn their vision, whether to the heaven above, or the earth beneath, or the waters under the earth, to our firesides or our public councils, there may they learn those laws of nature and of society, a knowledge of which may ennoble and purify the work committed by the Father to his children here below.

SCIENTIFIC LECTURE–II.

HUMAN LOCOMOTION; HOW WE STAND, WALK AND RUN.

By Burt G. Wilder, S. B., M. D.,
Professor of Comparative Anatomy and Zoölogy in Cornell University.

The second of the course of scientific lectures before the American Institute was delivered Tuesday evening, December 27th, 1870, in the Academy of Music, by Prof. Burt G. Wilder, of Cornell University. It was very profusely illustrated, and interesting practical experiments attested the truth of the lecturer's statements. Prof. Wilder said:

Ladies and Gentlemen.—During the past year I have spoken four times upon the subject of this evening's lecture; twice in Boston before the Lowell Institute,* and twice before my classes in the Cornell University.

The first time, I thought I understood the subject very well; but at each repetition I perceived more clearly the existence of matters which I could not explain, and to-night I freely admit that the points which are perfectly clear to me are vastly fewer than those which remain to be investigated.

You are incredulous as to there being anything abstruse or difficult to understand in the subject of human locomotion. "Anybody can stand; a very Hottentot can walk about; and the beasts themselves get over the earth after their fashion, occasionally even upon two legs like ourselves." Very true, but no one has heard a gorilla or a bear or an ostrich lecture upon the subject of bipedal progression; yet they employ it constantly or upon occasion; we all see and hear perfectly well; so does the most degraded savage, even better than ourselves; and yet, at the present time, the most learned physiologists are in doubt respecting the exact nature and functions of certain structures in the eye and the ear; every child knows a mosquito, and no very profound erudition is required in order to be bitten by one; but how few of us have any idea of the complicated apparatus by which our skin is pierced, the blood withdrawn, and poison instilled into our veins; and finally, wise as we think ourselves, big as we are now, and firm as we are upon our legs, there was a time when, as our parents will testify, we could not even stand upright; and we have gained the power to stand, to walk and to run, only by long practice, at the expense of much time and many hard knocks.

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* In a course of lectures upon Hands and Feet of the Mammalia, Jan. and Feb. 1870.

Dr. Holmes says: * "Walking is a perpetual falling with a perpetual self-recovery. It is a most complex, violent and perilous operation, which we divest of its extreme danger only by continual practice from a very early period of life. We find how complex it is when we attempt to analyze it. We learn how violent it is, when we walk against a post or a door in the dark. We discover how dangerous it is, when we slip or trip and come down, perhaps breaking or dislocating our limbs, or overlook the last step of a flight of stairs, and discover with what headlong violence we have been hurling ourselves forward." Of the complexity of walking, there can be no doubt, and I am convinced that if any ten now before me should undertake to come forward now into my place, and tell all the rest how they stand and how they walk, they would in the first place offer you as many contradictory explanations of the phenomenon, and if any one undertook to give the lecture over again he would contradict himself as flatly as I did when I delivered it for the second time. Now, granting all this, it is certain that I am not here to say everything that is or can be known respecting human locomotion.

How we Stand Upright.

Whatever be the mental and spiritual distinctions between man and beast, there is no doubt that the human body differs less from the body of a gorilla than this does from some of the lowest monkeys; the gorilla even stands upon its feet and "apes" mankind. But neither it nor any other ape or beast whatever stands *erect* like man; for in none of them are the head, trunk and legs so arranged as to be balanced one above the other in the same plane. This is the case in man alone. The human body is a perpendicular column composed of several segments which are accurately balanced upon each other. The head rests upon the spine in such a way that it tends to fall forward when we are asleep, rather than backward; but with all ani mals the jaws are so large and the point of attachment of the head to the spine is so far back that there is no balance whatever, and the weight of head requires large muscles in the neck; that we have no such muscles is evident when we get upon "all fours," for then the effort to keep the head raised, or in the position of a quadruped, is very fatiguing. In the gorilla, again, the spinal column itself forms but a single curve from the skull to the pelvis; but with man, it forms several curves, which compensate each other, and so becomes an elastic rod to lessen the jar in walking, while yet the place of attachment to the hip bones is just under the point supporting the head.

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* **The Human Wheel, its Spokes and Felloes; Atlantic Monthly, May, 1863.**

The hips themselves are so inclined forward that the whole trunk is balanced upon the heads of the thigh bones, and the legs, instead of being bent, as with most animals, are fully extended, so that hip, knee and ankle joints all lie nearly in the same plane, and the weight of the whole body comes upon the key-stone of an arch formed by the heel behind and the ball of the foot in front.

But a flexible column, such as has been described, with its heaviest parts above the middle of its length, would at once collapse and fall to the ground unless supported in some way; and so we find that on all sides the segments of the legs and of the head and spine are braced by muscles, which are in a state of constant though unconscious contraction, so as to maintain us in the erect position, while their power is so great, especially of those forming the buttocks, as to enable us to stand upon one foot and bend the body and leg, while supporting a heavy weight.

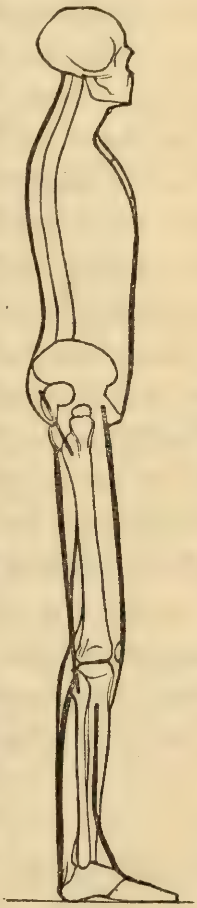

Fig. 1.

Diagram of man in the erect position, showing the position of the joints; the darker lines represent the muscles which preserve the balance.

Now all this has been often and well described, and I have spoken of it here partly to introduce the less perfectly understood subjects which follow, but chiefly to call attention to the fact that while many animals stand upon two legs, and may even approximate the erect position, yet man alone assumes it naturally and perfectly, his whole frame being adapted for it in a way not elsewhere seen. There is great significance in the erect position of man, for though it may differ but little from a slightly inclined position, yet that difference is like that

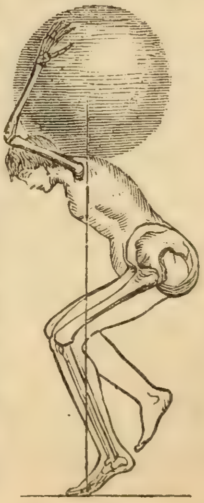

Fig. 2.

Diagram of a man bearing a heavy weight, and yet keeping his center of gravity over the point of support in the ball of the foot.

which separates the "just right" from the "nearly so," and causes the human body to point straight upward, while the fishes are horizontal and the other vertebrates seem to be striving in vain to raise their heads away from the earth heavenward. This being man's prerogative, and emblematic of his high origin and destiny, how strange that human beings should, even in sport, much less as a serious pursuit, train themselves to assume an attitude which is precisely that of the apes, in the so called "Grecian bend," which, I am happy to see, is gradually disappearing from respectable society. The head is disfigured by a ponderous *chignon*, which is comparable to the filthy masses of hair long cultivated by some low African tribes; to balance this unnatural weight, the head and body are tilted forward; one bad bend demands another, so the knees are bent and the heels raised, and the latter are propped up by those instruments of torture and disfigurement, high-heeled boots. The total result is an attitude which is as completely that of the orang-outang as the human body is able to assume, but no ape has ever been known to adopt a "bustle" in order to call still further attention to those parts of the body which his organization has caused to project. If the theory of derivation be true, then the artificial Grecian bend of the fashionable nineteenth century is a "reversion" to the natural monkey bends of our ancient ape-like progenitors.

HOW WE WALK.

In walking, the trunk and head are the *weight* to be carried; the legs have the *power*, and this power is exerted upon the feet, which form *fulcra* and *levers*, in connection with the floor or the earth; but we shall find that the body is not a dead weight, but elastic and alive, moving slightly in the direction needed to maintain the balance of the whole; so too, the legs are not merely *muscles*, they are also a considerable weight, and adapt themselves to the surface over which we are moving; and finally, although the feet are chiefly mechanical instruments, acted upon by muscles which arise higher up upon the legs, yet they have muscles of their own which strengthen the arch under the instep already described and give to all their movements a peculiar grace which is seen in no other creature; the apes have a much shorter heel, and the dactyls (toes) are so much longer and curved, that they cannot plant the whole sole flat upon the earth, but only the outer border; moreover, their primus (or great toe) is much shorter than ours and stands out from the side of the foot like a thumb, so that it cannot, like ours, receive the weight of the body and aid in the spring for the next step; the bear's pes, it is true is "plantigrade," like that of man, but the heel is short, the primus is shorter than the other dactyls, and the whole bony structure is so unlike that of the human foot, that instead of rising at the heel and springing from the toes, it is raised altogether, and put down again with a "flop," which is very much like the ungainly step of the negro minstrels.

Much more might be said of the peculiar structure and action of the human foot, which is a most interesting and useful part of the body, although much less is thought of it than of the hand, it is generally concealed from view, and the toes are the only parts of the body which have been thrown into disuse and seriously injured by civilization; we ridicule the Chinese for the distortion of their feet, yet our fashionable bootmakers are quite as guilty, since they abhor the natural form of the foot, and decide upon the proper shape of their wares with very little reference to the parts to be covered by them; the narrow sole, the inbent great toe and the elevated heel, are not a whit less ridiculous and injurious than the compressed foreheads of the Flathead Indians.

A good general definition of walking has been already quoted. The body is allowed to fall forward upon one leg, the other leg swinging forward like a pendulum, and planted at some distance in advance, this process being repeated for every step, the "leg-pendulum" of a short man swings of course more rapidly than that of a tall one; in the words of Dr. Holmes, "Commodore Nutt is to M. Bihin, in this respect, as a little, fast-ticking mantel clock is to an old fashioned, solemn-ticking, upright timepiece."

The same author makes the following statement: That a man is shorter while walking than while standing; and as the explanation of this fact involves most of the things I have to say, I will endeavor to show why it is so.

But first, is it a *fact?* There is a time when we rise upon the foot, and when one would expect the height to be increased. In proof that Dr. Holmes is right, we have, first, the evidence of ladies, who say that a skirt which does not reach the ground while standing, may sweep the ground while walking; and second, the experiment which I now try, of walking rapidly, with the eyes shut, under a rod which just touches the top of the head while standing under it; in order that this experiment shall be satisfactory, however, the following conditions must be observed: The rod must be steady and horizontal; the person walking under it should have no idea of its exact location, and should walk in a natural manner, neither "ducking" nor throwing the head back, as one is inclined to do when passing under anything; a little brush, filled with paint and set into a cork pinned to the crown of a hat so as just to touch the rod while standing will never touch it while walking under if the above conditions are observed.

Granting the fact, how shall we account for it?

First, we must distinguish between the *length* of the body and its *height.*

The length of the body is the distance between two parallel but not necessarily horizontal planes, coinciding respectively with the two extremes of the body, the vertex and the soles. This length will be greater or lesser according to the state of the *respiratory organs*, as I show by experiment; if the short arm of a lever be placed upon the head while the lungs are empty, the other arm will fall as soon as a breath is taken in; in part, this explains why a wrathful man looks taller, since he is generally holding a full breath.

This length will also vary according to the *attitude* of the body; for the different segments of the spine (vertebræ) are separated by elastic cushions of fibro-cartilage, which are compressed by the body's weight while in the erect position, but extend themselves when we lie down. This also is easily shown by experiment: A rule is fastened to a board, and the difference in height of a man while standing up and while lying down upon it is at once indicated by a sliding piece, like that of a shoemaker's rule. This experiment is more striking if some weights are held in the hands while standing. The compression of the intervertebral cartilages accounts for the familiar fact, that we are shorter at night than in the morning; and also for the stunting of young persons who are overworked, or obliged to carry great weights. Finally, the length of the body as a *whole*, varies with the position of the head, trunk and legs, or that of the segments of the legs, as is easily shown by experiment: If we stand under the short arm of the lever already mentioned, any inclination of the head in any direction will allow the long arm to rise; so will any bending of the trunk itself, or of the trunk at the hips, or of the thighs at the knees; the same result follows when standing upon one leg, for then the opposite side of the body is unsupported and sinks a little, while the middle of the body swings toward the supported side, so that trunk and leg are not in a straight line, but form an open angle at the hip.

That the whole body must be shorter when any of its parts are bent upon each other can also be proved by geometry. A straight line measures the shortest distance between any two points; when the body is erect and the legs straight, it coincides with a straight line, but when it or any of its parts are deflected, then it departs from the straight line and becomes part of a curved and therefore *longer* line, and as a part is less than the whole, the body is then shorter than before.

So much for the *length* of the body; its *height* is the distance between two parallel *and horizontal* planes, coinciding as before, with the vertex and the soles; in other words, the height of the body is measured upon a *vertical* line, while the length may be measured by *any* line; and, moreover, the height may be varied without a change in length, as when the body is inclined as a whole in any direction, yet preserves its erect position so far as regards its different segments; this, of course, could only occur while the body is supported by a board or other unyielding surface, but it proves the theoretical distinction between length and height.

Practically, the height of the body is affected by whatever varies the length, so that we reach the following conclusion: A man is at his average height in the middle of the day with the lungs moderately distended, when standing erect with both feet flat upon the earth and the trunk and limbs in the same vertical plane; his height is greater in the morning, and after a full inspiration, and when the feet are extended upon the leg; his height is less at night, after a complete expiration, when out of the perpendicular, or when any two segments of the trunk, head or legs are flexed upon each other.

Now, the time of day and the state of the lungs have no direct connection with locomotion, so that in the endeavor to account for the decrease of height while walking, we have to consider only the deflections from the perpendicular straight line which may occur during locomotion.

The most constant of these is the forward inclination of the trunk from the hips, in order to allow the weight of the body to aid in overcoming the resistance offered by the air, just as a rod carried upon the finger must be inclined in order to prevent the air from carrying it backward.

This inclination of the trunk may be hardly noticeable, as in slow walking, but when the speed is increased the resistance of the air is much greater, and it has been found that in rapid walking the trunk inclines forward at an angle of fifteen to eighteen degrees.* Of course it is possible to walk and even run with the trunk nearly erect, but in that case the resistance of the air must be overcome by muscular effort, just as a rod must be held very firmly in the hand in order to be carried forward in a vertical position.

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* Article "Motion," Cyclopedia of Anatomy and Physiology.

As has been already shown, the forward inclination of the trunk, since it is a deflection of the whole body from a perpendicular straight line, tends to lessen the height while walking, other things being equal.

The second deflection from the perpendicular is the lateral inclination of the trunk from the hips during all parts of a step in which the body is supported by a single leg. The center of gravity of the trunk lies between the hips, and a line dropped from it must always come inside the points of support; while standing upon both feet, this line will come between them, but when supported wholly or in part upon one foot, the center of gravity must be so shifted as to be over that foot, the whole body swings over toward the side of the supporting leg; but in order to preserve the balance, the trunk is not kept in the same line with that leg but remains nearly erect, and so forms an open angle with the leg. According to the proposition already given, this must lessen the height at all parts of the step excepting when the body is equally supported upon both feet, that is, in every position excepting the "rest," and the "heel," which will presently be described.

The movements of the legs themselves during walking are much less simple and easy of description, as any one may learn for himself by trying to follow his own movements and to describe them. At any rate, I have found no satisfactory account of them in books, and am far from convinced that the one I shall now give is correct in all respects; for in order to explain the decrease of the height during walking, we must not only know how each leg moves by itself, but also observe the coincidence in the movements of the two legs; and every one knows how difficult it is to watch two people carefully at the same time.

There are two methods of studying the various positions assumed by the legs during locomotion; the first is by means of the "instantaneous photographs;" in the article already referred to, Dr. Holmes reproduces four such figures, showing several points very clearly, namely; the length of the stride in rapid walking, the planting of the heel of the advancing foot, and the great elevation of the other heel just before that foot leaves the ground. But excellent and well chosen as are these figures, they are insufficient for our purpose;

chiefly because the *same* foot cannot be traced in its progress from the beginning to the end of the step, and because the several figures do not agree in height and attitude. I selected fifteen figures or groups from several hundred such stereographs, and had them enlarged by photography upon a single card; they illustrate the points above mentioned, and also the rapidity with which one foot swings by the other, since in some cases the lower part of the swinging leg is nearly invisible. Still I found it impossible to so arrange these figures as to show all the subdivisions of a single step with the same foot.

The other plan adopted is as follows: Having first carefully practiced and studied the various movements which occur while walking, and ascertained which are the most easily recognized positions, I mounted a table, and, by aid of a supporting rod, assumed these positions, and remained in each of them long enough to allow the artist* to make these diagrams. To these positions I have given names for convenience of description and reference; but it should here be stated that it is quite possible that they have been christened already by some German authors of papers upon human locomotion in Müller's Archive für Anatomie, which I have not yet been able to read in detail.

The position of "rest" (fig. 3), is that in which both feet rest flat upon the earth, the one perhaps a little in advance of the other; we are then at our greatest normal height; and in my own case, this is thirteen-eighths of an inch greater than the least height reached in the course of the step. The next position is called "ready" (fig. 4), because the body is swinging off to the left so as to be supported chiefly by the left leg, and the knee is bent slightly in readiness for the succeeding movement; the deflection from the perpendicular in this position diminished my height three-eighths of an inch, so that it was only ten-eighths of an inch greater than the least height. The next position is taken when the body is swung still farther to the left, the right knee more bent and the foot just raised from the ground so as to swing clear in the next movement; in this "raise" position (fig. 5) the height is still further decreased by two-eighths of an inch, so that it is just an inch above the least height. In the next position (fig. 6) the body is allowed to fall forward, and a *spring* is at the same time given by the foot, the heel of which rises from the ground; but although this, other things being equal, would tend to increase the height, yet so decided is the "fall" that, in my own case, the height was diminished three-eighths of an inch; but as this "fall" or "spring" position is not a real "position," but a continuous movement of the whole body, the exact decrease in height will vary from its beginning to its close in the next position. In this (fig. 7), the heel of the advancing foot comes to the ground, while the heel is still further raised, so that the body rests upon the heel of one foot and the toes of the other; and although the trunk is now nearly erect, and the elevation of the heel and toe tend to increase the height, yet the separation of the legs lowers the body another five-eighths of an inch, and the height is least (0) in this the "heel" position.

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* Mr. George Le Baron Hartt, of Ithaca, who has also drawn these diagrams upon wood for the present publication.

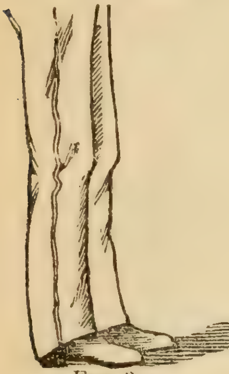


Fig. 3.
"Rest"—13-8.

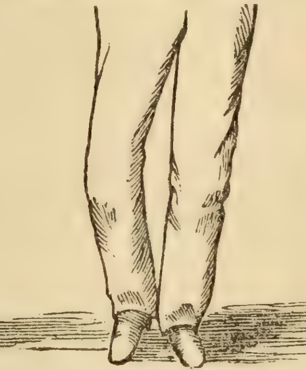
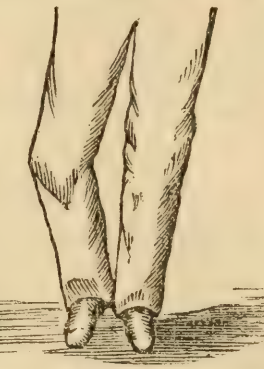


Fig. 4.
"Ready"—10-8.


Fig, 5.
"Raise" or "Swing"
—8-8.

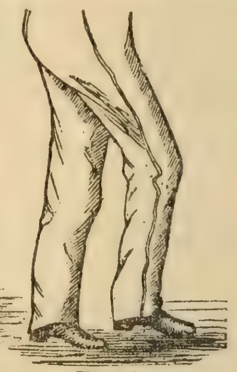


Fig. 6.
"Fall" and "Spring."
—5-8.

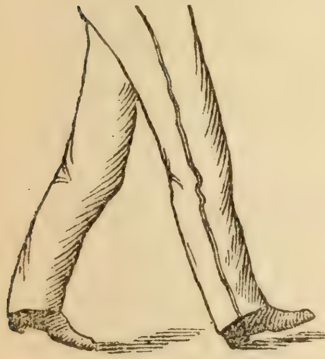


Fig. 7.
"Heel"—0.

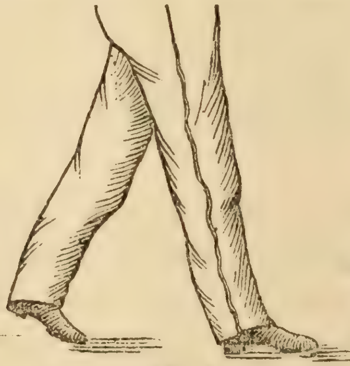


Fig. 8.
"Sole"—5-8.

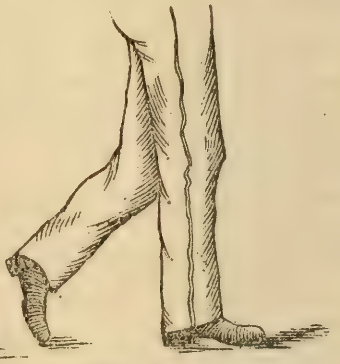


Fig. 9.
"Toe"—6-8.

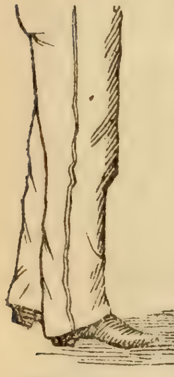


Fig. 10.
"Swing"—8-8.

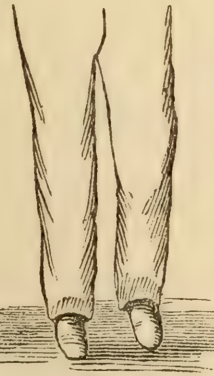


Fig. 11.
"Swing"—8-8.

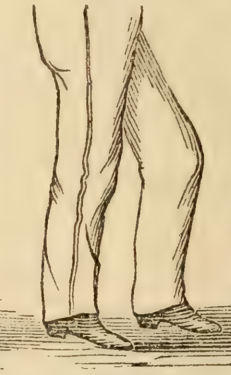


Fig. 12.
"Fall" and "Spring"
—5-8.

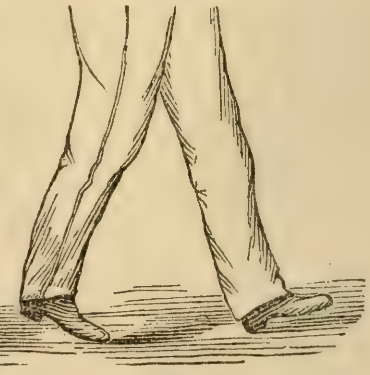


Fig. 13.
"Heel"—0.

In the next, or "sole" position (fig. 8), the heel rises still further, and the body is carried forward by the continued spring from the foot, the sole comes flat to the ground, and the height is increased by five-eighths of an inch; it would be even more increased but for the commencing deflection of the trunk toward the right; in the next or "toe" position (fig. 9) the leg comes more nearly into a vertical plane above the foot, but inclined to the right, while the heel rises until the whole sole falls backward, and only the *toe* touches the ground; the height is here increased by one or two eighths of an inch, and in the next or "swing" position (figs. 10 and 11) it rises to eight-eighths or just an inch above the lowest point, this being, in fact, the same position as that already described as the "raise" or "swing" (fig. 5). If we mean to close the step here, the left foot is planted by the side of the right in the "ready" position, and thencomes the "rest," in which the greatest height in attained. But if another step is to be taken, then the swing is succeeded by the "fall" or "spring" from the right foot (fig. 12), and then comes the "heel" position, as before (fig. 13), the body being supported by the *left* heel and *right* toe.

The Gradigraph.

Taking now a piece of chalk and holding it steadily against the blackboard, I take a single step forward and stop at the "heel" position; the chalk has made a downward curve; continuing the step and coming to the "rest" position, the chalk makes a corresponding upward curve reaching the level from which it started; in this way, the length of the step is indicated both by the length of the curve and by the difference between the highest and lowest points. At the same time, as may be seen by observing a person walking, from behind, and as has been already proved by our experiments, the head oscillates from side to side in each step; but each lateral curve is equal to two vertical curves, because, during a single step with the right foot, for instance, the head has swung off to the right side and *remains there*, while it has not only sunk to its lowest point but risen again to the highest; so that half of a lateral curve, is equal to a whole vertical curve, and in a series of these, one lateral curve is equal to two vertical curves, as already said.

While making these experiments, it occurred to me that a simple instrument might be devised which should register the lateral and vertical curves at the same time in such a way as to enable us to compare and study them. After various trials, which I will not here enumerate, the "gradigraph," or "step recorder," became the instrument which will now be used.

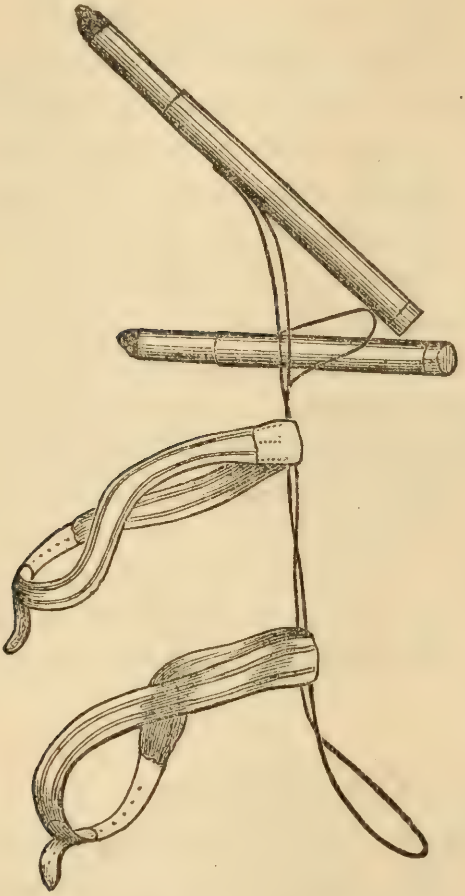


FIG. 14.
The "Gradigraph," or "Step Recorder," seen from the side.

It consists of two tin cylinders, one inch and a half in diameter, so attached to a frame of iron wire as to point forward at an angle of forty-five degrees, the upper one in a vertical, the lower one in a horizontal plane, and to the right. The lower and inner ends of the cylinders are closed; in each runs a hard wood piston upon a spiral spring. Each piston projects about four inches from its cylinder, and carries in its outer end a crayon of charcoal. For use, the frame is strapped firmly upon the back, so that the upper piston projects a few inches above the head, and the lateral piston a few inches beyond the right shoulder; the wearer then takes position beneath one board and at the side of another, so arranged that the crayons are in the center of the boards, and the upper piston is forced about two inches downward to enable the crayon to remain in contact with the upper board during the lowest position of the step; the wearer now steps forward in as natural a manner as possible, merely taking care to keep the lateral crayon in contact with the board. A series of vertical and lateral curves will be described, which, if faint, may be traced over with the charcoal. If the upper board is now let down so as to rest obliquely just above the lower board, these curves appear as follows:

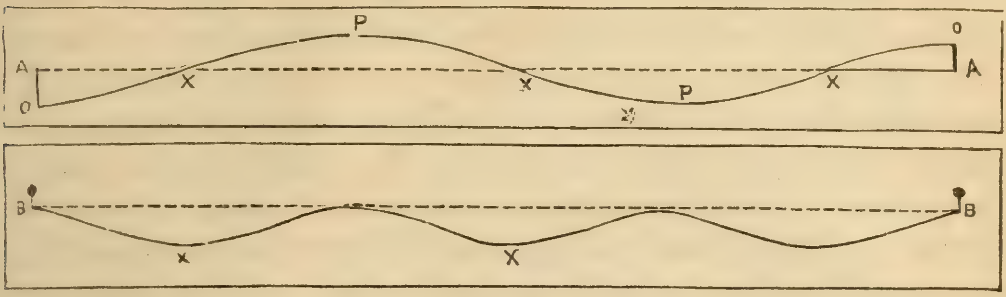


Fig. 15.

The above curves do not indicate the exact *amount* of either lateral or vertical oscillation; for, beyond the figures already given, I have not been able to make what may be called the quantitative analysis of human locomotion. The curves are somewhat exaggerated to facilitate comparison.

In comparing the curves produced by the gradigraph it must be borne in mind that the upper series are *lateral* while the lower are *vertical.* Although we cannot show them otherwise than upon the same surface, it will be noted, 1st. That each upper curve is equal to two lower curves. 2d. That the upper series are represented as lateral *oscillations* with respect to the dotted line A A, while the lower curves simply rise and fall with respect to the dotted line B B. 3d. That the extremes of departure of the upper curved line from the line A A coincide with the extreme elevations of the vertical line toward the line B B. 4th. That the points of intersection of the upper line with the line A A, coincide with the extreme depressions of the lower line from the line B B. 5th. That while each *entire* upper curve equals two lower curves, each lower curve coincides in length with so much of an upper curve as lies upon the same side of the line A A, so that X X is equal to Y Y. 6th. That at each end of each curved line is a short straight line at a right angle to the lines A A and B B.

Now, to state the same facts in connection with the movements of the body. The lower series represents the rise and fall of any part of the trunk, say the shoulder, from which the lateral barrel of the gradigraph projects. In the position of "rest" this point will have its greater elevation; but in preparing to take a step forward, the lateral swing of the body into the positions "ready" and "raise," causes this point to fall five-eighths of an inch (more or less). When the advancing foot has been planted and the position of "heel" is taken, the height is least; but then the body begins to rise upon the advanced foot until the "swing" position is reached, in which the height is the same as in the "raise" position, in which the real step began. Then another step is taken with the other foot, the body sinking and rising as before. Then the third step is taken with the same foot as the first and an indefinite series of similar curves would be formed, until we come to the "rest" position, when the body rises to the height which it had when starting. Each of these vertical curves measures a *step*, that is the space traversed by the trunk and head in passing from the "swing" position upon one foot to the same position upon the other; and this step is also the distance between the heel of one foot and the toe of the other in the "heel" position.

The upper series of curves represent the lateral oscillations of the head in respect to a line connecting with its positions when at *rest.* In preparing to take a step, the body swings off toward the side of the supporting leg, as shown in figs. 3, 4 and 11, and the head begins to advance, therefore, not from A, but from O; by the time the "heel" position is taken, with the advancing foot planted at a point under P, the head has moved back to the line A—A, but leaves it again and reaches P, while the body is advancing to the swing position in readiness for another step; then it again crosses the line A A at X, and describes a second curve, X—X; finally, having again reached the point O, if the position of "rest" is to be taken, the head comes back suddenly and without advancing to the point A.

Of course, the *length* of both lateral and vertical curves will depend upon the length of the step, and so will the *depth* of the *vertical* curves; but the degree of lateral oscillation of the head, as indicated by the upper series, depends not upon the length of the step directly, but upon the height of the individual, and also upon his width; for, in order to preserve the center of gravity over the point of support, of two men equal in *width*, the *taller* will oscillate the more; and of two men equal in *height*, the *wider* will oscillate the more. But there are also individual peculiarities of gait which may not depend upon either of the above conditions, and which would be merely indicated by a trial with the gradigraph.

This instrument is evidently capable of much improvement in detail, which I hope sometime to make, but I am convinced that even now it shows more clearly than has been heretofore, the relation of the lateral and vertical oscillations to each other, and the extent of each in the gaits of different persons; it may even be possible to give it such accuracy as to enable us to discriminate between the gaits of different nationalities as readily as we can now between those of the short and the tall man, between the natural, unaffected walk and the absurd "stage strut," which gives the most extensive lateral and vertical oscillations from the straight line.

The difference between the step and the pace is made evident by the curves produced by the gradigraph; each short curve is a *step*, for it measures the distance between the two feet in the heel position, and also the distance which the head and trunk traverse from the "rest" of one foot to the "rest" of the other; but each long curve measures a *pace*, or two steps, being the distance between the points where the same foot is raised and planted again; likewise the distance traversed by the head and trunk from the rest of one foot to the rest of the same foot, after two steps have been taken. If a man's step, then, is twenty-eight inches, his pace is fifty-six inches.

Besides the forward movement of the body in walking, and the lateral and vertical oscillations already described, there is a fourth movement, consisting of a partial revolution of the trunk upon its own axis during the "swing" position, when the trunk is supported by one leg; the whole trunk is faced a little to the opposite side; the shoulder and hip of the supporting side are thrown a little in advance of those of the opposite side, as becomes still more apparent when a pole is strapped across the shoulders; this partial revolution of the body probably occurs with all, during natural walking; although it is in part contradicted by the alternate swing of the arms, the left going forward with the right leg, and so generating a force in the opposite direction; with large persons it becomes more apparent; an exaggeration of this same movement, generally accompanies the "Grecian bend" already mentioned, and the "bustle" then receives a motion, which is aptly described by the German word "schwanzen," applicable properly, only to the waggle of the tails of monkeys and other beasts. If our comparisons seem odious, they are just, and even lack some of the features, which would yet more distinctly indicates the source of all these fashionable abominations among the *demi-monde.*

I have already mentioned the alternation of the swing of the arm, with that of the leg of the same side, or, in other words, the coincident forward swing of the left arm and the right leg, and of the right arm and the left leg; it is worth noting that this diagonal movement of the arms and legs, is precisely what occurs in the trotting of a quadruped, where the right hind leg and the left front leg are moved together forward and backward.

This brings us to a very curious matter, which is summed up by Dr. Holmes, as follows: One side of the body tends to *outwalk* the other side; that is, a person never goes in a perfectly straight line for any distance, but always turns to one side or the other, and at last describes a circle and returns to a point not far from where he started. Many such cases are on record, but I have not been able to learn to which side the turn was made; the Hon. John Stanton Gould informs me that he has frequently been lost in the woods, and thinks he turned without exception from *right to left;* that is, if he started to go due north he would deflect toward the west; he also mentioned a case of wandering in a circle by convicts who escaped from Clinton prison in this State, and referred me for further information to Mr. Ransom Cook, who was for a long time connected with the prison, and who has written me as follows respecting that case:

"The two convicts escaped from the prison about the middle of the day; they started north upon a run intending to go to Canada; they said they ran almost continually, until almost dark when they found themselves near the prison yard, about fifty rods further south than their starting point, while they had thought they were continually going north. They did not know in which direction they had turned, but it must have been quite abruptly to bring them back upon nearly the exact spot which they had left. I have been told by G. W. Beekwith, Esq., a lawyer of Pittsburgh, that it was a received opinion among hunters and woodsmen that lost persons traveled in a circle, turning to the left."

Now this is very interesting but not quite conclusive, and I would be very glad to have the experience of any persons who have been lost and have traveled in a circle; the experiment might even be tried by letting a man, unprejudiced, walk blindfold over a great plain covered with a light snow. I have tried an experiment upon a very small scale in a room forty feet long, trying to walk along a seam of the carpet with my eyes shut; in nine cases out of ten, I found my deflection to be to the *right;* and although I by no means regard such a trial as satisfactory, the result certainly accords with some facts already ascertained; for the greater propelling power of the right foot would cause the whole body to revolve more toward the right, and so turn the person toward the right, instead of the left side.

In this connection may be mentioned two facts which seem at first to contradict each other; the first is, that as a rule, the left leg is used for supporting the body, while the kick is delivered with the right, indicating the greater power of that foot; the other is that in marching, the time is marked by "left," "left," "left," spoken at the moment the left foot is swung forward to be planted in advance; and this would indicate that the left is the more important foot in walking, but not really; for although the left foot takes the step, the spring which determines the length and force of that step or movement, is given by the right, and it is said that in some cases a careful measurement of the steps shows that the impulse given by the right foot carries the left foot an inch or two farther than the right foot is in turn propelled by the left.

HOW WE RUN.

Between the walk and the run three differences will suggest themselves:

1. Running is faster than walking.
2. In running, the body is more inclined forward.
3. There is a greater spring in running.

But although these distinctions generally exist, they are not essential; for, (1.) You *may* walk much faster than you *may* run, although you *can* run the faster. (2.) You may walk with the body bent forward, and you may run with the body nearly erect. (3.) You may spring more, and so rise higher, in walking than in running.

There is, however, one difference between walking and running, which is less apparent, but is really the only essential difference. It is, that at every period of the step in walking some part of one or both feet is upon the ground; the body is always supported; but in running, there is a moment when the body is wholly unsupported, when both feet are off the ground.

Now let us note the movements in running. We may start from a standing position upon the flat of one or both feet; but after once starting, the heels rarely, if ever, touch the ground, and the ball of the foot both receives the weight and makes the spring. After starting, too, there seems to be only two real stages instead of five: one when the right foot is springing and the left is swinging forward; the other when the left is still in the air and the right also has left the earth; then the left comes down and makes the spring, while the right swings forward in its turn. The result is, that at one instant the body is supported by the ball of one foot, at the other instant by nothing at all; and this constitutes the main and essential difference between walking and running. Some figures of the appearance of the feet in walking and running I have given in "Bird, Beast and Fish," *Harper's Magazine* for November and December, 1869, and January and February, 1870. But the careful reader will observe that the descriptions are not the same as here given, and will be convinced that I am right in supposing still better ones will be given hereafter.

There are several other modes of human locomotion. We may hop upon one foot, or jump upon two; we may also leap upon two, but in leaping the two feet are not together as in jumping; and, finally, we may vault from one or both feet, aided by one or both hands. Springing, bounding and skipping are varieties of leaping, according to the relative height and length of the movement.

But our time has expired. I do not pretend to tell you all that is known, much less all that may some day be learned upon the subject of human locomotion; and although I hope to have made some points clearer than they were before, I am so little satisfied with my own explanation, that I am willing you should remain convinced of but one thing, that the most common actions of the body require careful attention; and that no branch of natural history, however minute, can ever be followed to the end; we may tire of it, and lose our hold of it; our successors may find in it more than we, but God alone knows all the fruit it may bear.

SCIENTIFIC LECTURE--III.

THE TRIUMPHS OF MODERN SURGERY.

By Frank H. Hamilton, M. D., LL. D., Professor of Surgery in Bellevue Hospital Medical College, New York.

The third lecture of the scientific course before the American Institute was delivered Friday evening, January 6, 1871, at the Academy of Music, by Prof. F. H. Hamilton, on "The Triumphs of Modern Surgery." Prof. Hamilton said:

Ladies and Gentlemen.—To one who has devoted a large portion of his life to the subject of surgery, who has himself been a witness of many of its failures and successes, who has had occasion at one time to lament its insufficiency, and at another to exult in its triumphs, the theme which I have chosen for this evening's discussion is full of interest; but I cannot very well understand how you can be attracted by a narrative of events which are so much out of the usual course of popular thoughts and tastes, and which are constantly invested with painful and tragic associations. This is the subject, however, which I have ventured to intrude upon you, trusting that it will not prove wholly uninteresting even to the present audience.

Barber Surgeons.

Strolling one day along the Strada Toledo, in the ancient Saracenic city of Palermo, threading my way among the numerous stands which encumbered the sidewalk, jostled by banditti-looking soldiers, and pursued by beggars asking for alms, my attention was arrested by a barber's pole, upon which were suspended two copper basins and a horse's tail, while above the lintel of the door was a coarse painting, representing Seneca in his bath, bleeding from a dozen orifices. Recognizing in this singular sign the shop of a *Sallassatore*, the modern representative of the ancient barber-surgeon, I had the curiosity to enter and make the acquaintance of this descendant of my fathers. The occupant and proprietor was a young man whose crisp hair and swarthy complexion indicated plainly his Moorish origin. Apologizing for the intrusion, and explaining to him that I came as a pupil and not as a patient, I was permitted to examine at my leisure the apartment and its fixtures. The shop or office of the *Sallassatore* differed very little from any barber's shop which you may have seen, except that it had not the usual air of comfort and neatness; and the boxes, numbered and arranged for the regular customers, contained, in addition to the shaving cup and brush, a roller to be used in case of bleeding. There was also upon the opposite side of the room a small case well filled with salves, plasters, lint and bandages; and upon the floor stood an upright rod, supported by a tripod, which the patient grasped when about to be bled. The horse's tail which I had seen at the door, and of which a duplicate lay upon the table, was used, as the proprietor explained to me, in brushing away the flies, when their patrons were undergoing either surgical or tonsorial operations. The usual supply of razors, strops and scissors, with a few chairs, completed the furniture. The information which I had gained was meager, but my curiosity had been satisfied, and thanking him for his courtesy to a stranger I went out.

Throughout the south of France, in Italy and in Sicily, the *Sallassatori* perform most of the minor operations in surgery. They furnish to their customers healing salves for ulcers, and discutients for cancers and tumors. They bind up wounds, mend broken bones, and reduce those which are dislocated. They leach, pull teeth, shave, cut hair or point an imperial, and bleed by the ounce or pound. Their art, as if limited by a hereditary and perpetual bond or obligation, has almost precisely the same proportions which it had near the close of the fourteenth century, at which period, and, indeed, quite down to the sixteenth century, the barbers were almost the sole representatives of the profession of surgery. Perhaps nowhere so much as in Europe do we meet with such examples of mediæval customs and practices, existing unchanged in the midst of modern civilization and progress, like long shadows projected into noonday light. They may be seen in the implements of agriculture, in the modes of travel, in the costumes, manners, and superstitions of the people. Paganism mingles with Christian theology; feudal and divine rights are maintained by popular suffrage and a representative government; the doctrines and practices of the past forming everywhere strange contrasts with the present.

These absurd admixtures and contrapositions of light and shadow, of old and new in the same picture, serve, however, a useful purpose to the historian, since they enable him to measure more accurately the progress of events; and in the present instance it permits me to contrast the representative surgeon of the middle ages, as seen in the uneducated Sicilian barber, with the representative surgeon of the present period, as illustrated by a Nelaton, a Langenbeck, a Sir Astley Cooper, and a Valentine Mott; to compare the scope and character of the operations then performed, as indicated by the symbol at the door of the *Sallassatore*, with the multitude of expedients now adopted for the relief of deformities and the preservation of life; to place in opposition the relative subjection of the mechanical arts to the purposes of surgery, when a lancet, a bistoury, a cauterizing iron, and a pair of scissors composed a surgeon's entire outfit, to the numerous and often wonderfully ingenious instruments which furnish the surgeon's arsenal to-day.

EARLY HISTORY OF SURGERY.

It is not to be understood that, prior to the general decay of letters, surgery had made no progress. There can be no doubt that surgery was practiced in some manner from the earliest periods of human existence; but the first written accounts we have of our art are derived from the Greeks, according to whom Apollo was the God of medicine and surgery, as well as of music. At length, however, Apollo resigned the department of medicine and surgery to his son Æsculapius. Homer has celebrated the fame of Machaon and Podalirius, sons of Æsculapius, who accompanied the Greeks to the siege of Troy, 1192 years before Christ. Machaon being wounded by Paris, Achilles brought old Nestor to take good care of him. "For" he says, "a leech who, like him, knows how to cut out darts, and relieve the smarting of wounds by soothing unguents, is to armies more in value than many heroes." In direct descent from Æsculapius came Hippocrates, who was born in the island of Cos, 460 years before Christ. He was the first to leave any written records of his opinion, and practice in surgery.

But it is not my intention to review the early history of surgery, which, gradually in the succeeding centuries advanced to the rank of a science, and was illustrated by many distinguished Greek, Roman, and Arabian surgeons. Whatever stores of surgical knowledge had been accumulated were in a great measure lost, or lay buried in the libraries of the priests and monks, during the period intervening between the fifth and fifteenth centuries. The discovery of the art of printing by Laurentius of Harlaem, about the year 1429, paved the way for the revival of letters; and surgery was among the first to awaken from her long sleep; but no durable foundation was laid until the beginning of the next century, when anatomy was first taught systematically from human dissections, in Padua by Vesalius, a native of Brussels. Herophilus and Erasistratus, distinguished Egyptian surgeons, under the protection of Ptolemy Soter, had been permitted, about 300 years before Christ, to open and inspect the bodies of executed criminals; and similar privileges had been extended to other surgeons in later times; but neither the Greeks nor Romans encouraged dissections, while the study of anatomy was strictly forbidden among the Mohammedans.

AMBROISE PARE—LIGATURE.

Ambroise Paré, born at Laval, in France, in 1509, was a member of the fraternity of barber-surgeons; but, such was the reputation he acquired as an operator, he was made surgeon to four successive sovereigns of France, and, among others, to the weak and cruel Charles IX., by whom, however, although Paré was a Huguenot, his life was saved on the terrible night of the massacre of St. Bartholemew by detaining him in the royal chamber until morning. With Paré, who lived little more than 300 years ago, we may commence to date the achievements and triumphs of modern surgery. Hitherto, after amputations, the bleeding vessels had generally been secured by searing them with cauterizing irons, or by dipping the end of the stump in boiling oil or molten lead. Paré revived the ligature, which, although it had been suggested, and probably adopted in a few cases several centuries before, had been forgotten or abandoned by his immediate predecessors. Such was the mortality under the old process of securing the vessel, that Guy de Chauliac declared it was better to let the limb drop off than to amputate with the knife; and he advised ligating firmly at the nearest joint, and thus to cause gangrene and sloughing of the limb below. Since Paré wrote, great improvements have been made in the application of the ligature, and its usefulness has been greatly extended; especially is it proper to mention its application for the reduction of vascular tumors, including elephantiasis, for the relief of epilepsy, and for various other maladies in which it is known that organs are suffering from an excess of blood; but the greatest achievements of the ligature have been in the cure of aneurisms.

ANEURISMS.

The arteries which convey the blood from the heart to the various portions of the body consist of a trunk with many branches. When at any point the walls of a vessel give way and become expanded into a tumor, called an aneurism, threatening a sudden and complete disruption, it becomes necessary to tie the artery on the side nearest the heart; and, as Mr. Hunter has shown, sufficiently remote from the aneurism to insure a healthy condition of the vessel at the point of the application of the ligature. You will now understand how essential to the surgeon is a knowledge of minute anatomy; and how impossible it was to have saved the lives of these patients, or to have performed many other operations in surgery, in those periods of the world when human dissections were not permitted. Nor, let it be understood, can a practical knowledge of anatomy be acquired by a study of the most carefully-executed models, prints or colored drawings. They furnish valuable aid to beginners, and serve a useful purpose in refreshing the memory; but to know how safely to tie an artery, lying deep within the living body, surrounded by muscles, nerves and veins, in the neighborhood of viscera whose lesion would be fatal, the operator must have made careful and repeated dissections upon the cadaver. His knife must be guided by a steady hand and an intelligent brain. Like the mariner among the rocks in a dark night, he must be able to avail himself of every object which by accident comes into view to direct his course.

Aided by the exact knowledge thus obtained, and profiting by the experience of those who have preceded them, surgeons have advanced from the ligature of one artery to another, until at length the two largest arterial trunks in the body have been tied; and, in the case of one of them, the ligature has been applied successfully almost at the very point at which it emerges from the heart. For example, the femoral artery, which supplies most of the lower extremity, was first tied for aneurism by Hunter, according to the method which has received his name, about the year 1785. At the present day, the same operation has probably been performed successfully many thousand times. In 1796, Abernethy, the great Scotch surgeon, tied the external iliac. In 1812, Dr. Alexander Stevens, whose death took place in this city only about two years ago, tied successfully the internal iliac; an operation which was soon repeated by Atkinson and Mott, of New York, and by White, of Hudson, on the North River. Up to this date this latter operation has been performed nine times, with four successes. Gibson, of Philadelphia, first tied the common iliac, in 1812, in the case of a wound, but unsuccessfully. It was reserved for Dr. Mott, in 1827, to make the first successful operation on this artery, in a case of aneurism.

To appreciate the skill and the boldness requisite for its performance, it must be understood that the artery in question lies at a great depth within the cavity of the belly, near the backbone; and that to reach it, the operator must carry his dissections in a circuitous route from before, around the viscera to the back. Moreover, this great trunk is the only direct channel of supply for the whole of the lower extremity. How could the limb survive the complete interruption of its nutritious channels? Experience had already shown that a great part might with impunity be cut off, as in the case of the ligation of the femoral and external iliac, the dilatation of the small collateral branches and their inosculations being sufficient speedily to restore the normal circulation. But how was it to be with the common iliac? No one could say. Mott made the experiment, and succeeded in saving the life of his patient. The operation has now been made with equal success many times, and it has accordingly taken its place as one of the established expedients of surgery.

In the upper extremity, Dr. Wright Post, of New York, was the first to ligate successfully the subclavian artery outside the scaleni muscles. Dr. J. Kearney Rogers, well known to our older citizens as having been in his day, one of our most distinguished surgeons, ventured, in the early part of the present century, upon the hitherto untried experiment of ligating the subclavian artery upon the left side, within the scaleni. The operation failed, as Dr. Mott, who was present at the time, predicted it must. Nor has any one ever yet succeeded in saving the life of the patient when the ligature has been applied within the scaleni, on either side of the neck. It is not, therefore, entitled to be called a surgical triumph; but those who are familiar with the anatomy of this region will concede that its successful execution must exact, on the part of the surgeon, an amount of skill and boldness which is rarely possessed.

The common carotid artery, the great artery of the neck, which furnishes the chief supply of blood to the head, was first tied for aneurism by Sir Astley Cooper, in 1805; but this was unsuccessful. He repeated the operation, however, with success, in 1808. Dr. Wright Post, of New York, was the first successful American operator; since which time, few surgeons of much experience have not repeated the operation.

INNOMINATA—DR. VALENTINE MOTT.

The crowning triumph of the ligature remains to be mentioned. The innominata is that great artery which, arising from the aorta, near the heart, lies through its whole course entirely within the cavity of the chest, being only about one inch and a half or two inches in length, and then dividing into the right carotid and right subclavian, which supply respectively the right side of the head and the right arm. This artery was first ligated by Dr. Mott, then thirty-three years of age, on the 11th of May, 1818, in the old city hospital on Broadway. The patient survived only twenty-eight days. The operation was, therefore, unsuccessful; but the possibility of its ligation in the living subject had been demonstrated; it had been proven that the circulation would be speedily restored in the parts thus suddenly deprived of blood, and the causes of failure had in some measure been ascertained. Encouraged by the delay in the fatal issue of Dr. Mott's case, the operation was repeated from time to time until six successive failures led the great French surgeon and the friend of Mott, M. Velpeau, to say, "Is it not enough to pronounce an inexorable verdict against such an operation, and," he adds, "I do not hesitate formally to proscribe it." Other surgeons reiterated the sentiment expressed by Velpeau. Nevertheless, Dr. Mott was not without hope, as he himself has said, "that some one is destined, in the brilliant march of surgical triumphs, to meet with success. My hopes" he adds "are not at all dampened by the hitherto repeated failures of this operation; and I fully anticipate that the day may come when some one of my countrymen may yet be heralded as the successful operator. I am free to say that if ever a case should present itself to me again, I should tie the primitive carotid at the same time that I tied the innominata."

These were the hopes and declarations of Dr. Mott in 1846. During the subsequent years the operation was again and again repeated by surgeons until the total number of failures was thirteen, not including four cases in which surgeons of great skill had commenced the operation and found themselves compelled to desist, leaving the operation unfinished. No one had yet fulfilled the prophetic anticipation, and been heralded as the successful operator. Dr. Mott, however, as I know from personal conversation with him, never relinquished his confidence in its final triumph. Nearly half a century had elapsed since he first tied the innominata, when he received the intelligence that Dr. J. W. Smyth, of New Orleans, had been successful, having tied not only the innominata and common carotid at the same time, as suggested by Mott, but subsequently also the vertebral. This operation was made in 1864, and at the last accounts the patient was in complete health. Dr. Mott had been permitted to live to see his judgment vindicated, and his prophecy doubly fulfilled. The operation had not only been successful, but one of his own countrymen had been the successful operator.

Sir Astley Cooper, in 1817, ventured to tie the abdominal aorta, but the patient survived the operation only forty hours. The ligature has failed when applied to the aorta in two other cases, but since the introduction of anæsthetics, another surgical expedient has become available; and Mr. Murray, of Newcastle-on-Tyne, has cured an aneurism of the abdominal aorta by *compression*, continued uninterruptedly for five hours, the patient being meanwhile under the influence of chloroform. To the Dublin surgeons, and especially to Bellingham, Tuffnel, Hutton, and Carte, are we indebted for the introduction of compression as a means of curing aneurisms when the ligature is inapplicable. Compression has been employed in one way or another since the close of the seventeenth century, but not till 1842 was the principle upon which alone success can be reasonably expected fully ascertained. In addition to these means, we have of late learned that cures may be effected by manipulation, position and electrolysis.

AMPUTATIONS.

In the amputation of diseased and broken limbs, surgery has made very great advances in modern times: First, by the substitution of the ligature for the cauterizing irons and other barbarous modes of arresting hemorrhage, as has already been stated. Lately, however, it has been proposed to substitute for the ligature a method technically known as "acupressure;" and by other surgeons "torsion" of the vessels has been recommended and practiced. Both of these methods of procedure are still under judgment; and they will not demand of us, therefore, a more particular notice. One of the most important questions in amputation is that which relates to the period of time after the receipt of an injury at which it is most safe to operate. To determine this question, the hours, days and weeks succeeding upon the accident are divided into periods, termed respectively the "immediate," "primary," "intermediate," and "secondary," but which I shall name for the convenience of explanation: First, or period of shock and depression, which continues in most cases from six to twelve hours: Second, the period of moderate reaction, terminating usually within twenty-four or forty-eight hours: Third, the period of inflammation, extending from the time at which full reaction takes place to the tenth or fourteenth day, more or less: and Fourth, the period of suppuration. A comparison of the results in a sufficient number of accurately recorded cases has at length determined that the four periods stand in the following order of relative safety: The second, or period of moderate reaction, is the most favorable; the third, or period of inflammation, is the least favorable; the first and fourth periods occupying about the same rank, namely, less favorable than the second and more favorable than the third. One of the practical inferences drawn from these facts is, that the first duty that a surgeon upon the field of battle has to perform, in a large proportion of those unfortunate cases in which the limbs demand amputation, is to administer a little wine, with a few words of encouragement, and to pass on to those in whom reaction having taken place, the condition is more favorable to success.

Another question, undetermined until within a few years, is at what point is it most safe to make an amputation? Thus, for example, if a limb is hopelessly shattered or destroyed as high as the knee-joint, will it give the patient the best chance of life to amputate at the knee, or to avoid this joint, and remove with the leg a portion of the thigh? Fifty years ago joint amputations were regarded as extra hazardous; but the results of a larger experience, carefully collated, have proven that this opinion was erroneous, and we have at length been able to establish a law, which in every point of view is of the greatest importance to the patient who is to suffer amputation, namely, that in all cases the surgeon must save as much of the limb as possible, without reference to the question whether, in so doing, he is compelled to amputate at a joint or through the shaft of a bone.

It will interest you, I think, to know the process by which this conclusion has been reached, and the amount of careful statistical labor which nearly all similar deductions, relating either to medicine or surgery, have cost.

Passing over a large number of tabulated statistical records, drawn from various sources, in early and later times, the testimony of which has been gradually converging toward the same point, but which could not yet be deemed conclusive, it has been ascertained that in the British army, during the Crimean war, the mortality after amputations of the forearm was seven per cent; of the arm through the shaft, nineteen per cent, and of the arm at the shoulder-joint, thirty-five per cent. In the case of the lower extremity, amputation of the foot presented a mortality of sixteen per cent; of the leg, thirty seven; of the thigh, sixty-four, and of the hip, 100; not one having been saved when the amputation was made at the hip-joint. The records of amputations made in the federal army during the war of the rebellion have not yet been completed, but 13,397 cases have been examined and recorded in the Surgeon-General's office at Washington, and the results ascertained in 9,705 cases. The per centage of mortality is as follows: In the case of the upper extremities, fingers and hand, one per cent; wrist-joint, five; forearm, sixteen; elbow-joint, nineteen cases, and no deaths; upper arm, twenty-one per cent; shoulder-joint, thirty-nine. In the case of the lower extremities, toes, a fraction of one per cent; partial amputation of foot, nine; ankle-joint, thirteen; leg, twenty-six; knee-joint, fifty-five; thigh, sixty-four; hip-joint, eighty-five.

It is in this way that war, in itself a barbarous and inhuman art, is made subservient and tributary to the progress and perfection of a humane science. Let us hope, therefore, that in these faithful annals of the sufferings of our wounded soldiers made by our own surgeons during the late war, and in the similar records obtained from other battle-fields, the world will find some compensation, if not actual cause for gratitude, since they have added so many new *fasciculi* to our stores of knowledge; and since it is not impossible that the lives which will be thereby saved will outnumber those which were lost in battle. "It is one of the happy privileges of military surgeons," says Armand, "to draw from the state of war precepts which console humanity, by turning to his profit the observations and the treatment which follows in its train."

HIP-JOINT AMPUTATIONS.

The first hip-joint amputation was made by Kerr of England, in 1774; but it did not become an established operation until after Larrey, in 1793, had made the operation in the French army. Since then it has been made in civil and military practice a great many times. The best statistical record of the published cases, made by Dr. Otis, of the United States army, furnishes 219 examples of this amputation, of which fifty-six recovered, and 163 died. Fifty-three of these examples occurred in the federal and rebel armies, during the late war. Of this number six recovered. Let it be understood that this operation is never made when any other alternative for saving life is presented; and it will be seen that, so far as human judgment can determine, we have saved six lives by the operation during the late war, and to the world at large there have been saved fifty-six lives.

One question, however, hitherto undetermined (relating to the hip-joint amputations), has at last, and by one of our own army surgeons, been decided, namely, whether the life of the patient can ever be saved when it becomes necessary, as the only alternative remaining, to make an immediate or primary amputation at this joint, after a gunshot injury. In all, seventy-two immediate and primary amputations at the hip-joint have been made for gunshot injuries, of which sixty-eight were certainly fatal, and three are undetermined. Up to the period of our late war there was not an authenticated example of recovery. In 1861, Stromeyer, one of the most distinguished German surgeons, declared that "it was not yet proved that amputation at the hip-joint was deserving of a place among the resources of military surgery," and Sedillot of France taught that primary amputation at the hip was always fatal. But on the 29th of May, 1863, Edward Shippen, surgeon of volunteers in the United States army, amputated the thigh of James E. Kelly at the hip-joint, on account of a gunshot wound, within seven hours after the receipt of the injury, and the man still lives and is in the enjoyment of perfect health. There were also two other examples in the rebel army in which this amputation was made at the same period, and the patients survived several months, but their final histories could not be traced. The possibility of recovery after the operation having been determined, it is now believed that with the improved means of controlling hemorrhage which we possess, in the lately invented aortic compressor, we shall in the future be successful in a larger proportion of cases.

RESECTIONS.

But amputations have, with some reason, been classed among the opprobria of our profession, inasmuch as they propose to cure only by ablation of the diseased limb. They imply a confession that the disease or injury is beyond the resources of our art, and that life can only be preserved by dismemberment of the body. Modern surgery has, therefore, sought to interpose some less serious alternative ; and this has been found, in many cases, in what is termed resection or excision. For example, a joint, such as the elbow, the shoulder, or the hip, being incurably diseased or shattered, and it having become manifest that the general system can no longer endure the local disturbance without extreme danger to life, the surgeon first considers whether excision of the joint ends of the bones may not be substituted for amputation; since experience has shown that by this procedure the diseased or injured structures may be often quite as effectually removed as by an amputation, and with no greater risk to life, while a more or less useful limb is preserved. In some cases it has been found that the limb, although shortened, has retained all of its former strength and latitude of motion, and is quite as useful as it was originally. In other cases its usefulness is impaired by the operation, but there is only required some mechanical support to restore completely the powers of locomotion and prehension. I should do injustice to those artizans who have contributed so much to the perfection of surgery by their ingenious mechanical contrivances, if I did not make special mention of them in this connection. To them we are constantly indebted for many original suggestions, and for the execution of our own plans of surgical apparatus and instruments. Artificial limbs for those who have suffered amputation, and mechanical supports for limbs which have been resected, have attained in their hands a wonderful degree of perfection and adaptability for the purposes intended; and in some cases seem to leave nothing to be desired but sensation, to render them equal to the animate originals for which they have become the substitutes.

Operations of excisions are, however, not limited to the joints. We practice excision of such parts of the bones as demand removal in any portion of the shafts of long bones. Smaller bones are frequently excised entire; and in a few instauces the practice is extended to the whole of the shaft of a long bone. But what will surprise you most in this connection is, that we find that with proper management, taking care to make the operation at a suitable time, and carefully preserving the periosteum which is the immediate investment of the bone, a large portion of the osseous structure, and in a few instances the entire bone, will be reproduced. This branch of our science, namely, osteogenesis, has been especially studied within the last few years, and the practical results already attained are remarkable.

ANAPLASTY—(RHINOPLASTY, ETC.)

Anaplasty, or the repair and restoration of mutilated and lost parts, has been practiced for a long time. Tagliacozzi acquired, about the middle of the sixteenth century, great celebrity in the construction of noses from the skin of the arm. The Koomas of India, among whom the loss of the nose was inflicted as a penalty for various crimes, constructed noses from the skin of the forehead, and this is the method now generally adopted by surgeons, but which, in the progress of time, has undergone many changes and improvements, so that if at this day we cannot always furnish to order a Grecian or a Roman nose, after the most perfect models, we may at least insure to our patients a nose entitled to respect, and sometimes deserving of admiration.

In like manner, surgeons of our day do not hesitate to attempt the formation of an eyelid, or to supply the loss of any portion of the cheeks, and in other cases to relieve the disfigurements of the face or neck, caused by burns and other accidents. A great number of these operations have been made by our surgeons since the close of the war to remedy those terrible deformities caused by gunshot wounds.

Operations for the relief of hare-lip, a congenital deformity, are probably familiar to you all; but it is a proper subject of congratulation that while Roux, a distinguished French operator, declared thirty years ago that one out of every four operations must be expected to fail, with our improved methods not one in twenty or thirty results in failure.

The attempt to close a cleft in the soft palate was first made by Roux in 1819, upon a medical student in Paris, since which time the operation has been improved, especially by a more precise knowledge of the functions of those various and beautifully arranged muscles which control the palate, and by the action of which the success of the operation in the earlier attempts were often defeated. J. Mason Warren, of Boston, was the first to divide these muscles, to insure rest to the palate during the process of union. Mr. Fergusson, of London, one of the most distinguished living surgeons, and Mr. Pollock, of St. George's Hospital, still further improved upon the suggestions and practice of Warren, and reduced the operation to a strictly anatomical and scientific basis.

In the process of time, also, the operation became extended to the closure of a cleft in the roof of the mouth; and by Langenbeck of Germany, it is claimed that he sometimes is able to form a bony roof, resembling in all respects the natural roof. This operation does not differ essentially from that practiced by Warren, who not only had great success in closing the soft palate, but also in closing fissures in the roof of the mouth. Indeed it is my opinion, after a careful study of the subject, that the world is more indebted to Warren for this ingenious operation than to any other man. My reasons for this opinion I have given elsewhere, and I shall not occupy your time in repeating them on this occasion. I will, however, refer you to what

Mr. Fergusson recently said in one of a published series of lectures which he had the kindness to send to me: "Those who have devoted attention to cleft palate during the last twenty years," says Mr. Fergusson, "must have been surprised at a recent dispute as to priority in separating the soft from the hard palate, with a view to close the cleft in the hard. Dr. Mason Warren described this process in 1843, and it was referred to in my original paper. I myself performed it in January, 1845, and have since repeated it on fitting occasions." * * * "The first idea I had of this portion of the operation for cleft-palate was obtained from Dr. Mason Warren. I deem it but fair to the reputation of that distinguished surgeon to state that I know of no originality before his, and that I look upon all modern claims to such originality as arising from either ignorance or a desire to rob the fair reputation of a name which in son, as in father, will stand for generations among the brightest in surgery." Speaking in a general way of operations made both upon the soft and hard palate, Mr. Fergusson says also: "In so far as I know, the greatest success recorded before my own views were made public, was that achieved by Mütter, of Philadelphia. In 1843 he had operated successfully on nineteen out of twenty-one cases; and J. Mason Warren, of Boston, had been successful in thirteen out of fourteen cases."

It is admitted, however, that there still remain examples of cleft-palate which, on account of the great size and breadth of the chasm, it is impossible to close by a surgical operation. It is a matter of just congratulation, therefore, that here again mechanical substitutes have supplemented and, in a great measure, perfected what legitimate surgery had failed to accomplish. Many ingenious devices have been contrived from time to time as substitutes for the natural palate; but nothing has ever equaled in simplicity, ingenuity and adaptability, that made of vulcanized rubber by Norman W. Kingsley, a well-known dentist of this city. It possesses, in a most remarkable degree, the flexibility of the natural palate, and is even subject, in a great measure, to the control of the muscles. Mr. Pollock, in an address made to the Odontological Society of London, a printed copy of which is now before me, says of this apparatus: "I look upon it as one of a series of those very great improvements that have come to us from the other side of the Atlantic, which have conferred so much benefit on mankind."

VESICAL FISTULÆ

The name of Sims and Bozeman, both of whom we are proud to claim as fellow-citizens, are known to-day wherever civilization extends, as having, by their original discoveries, and by their skillful application of principles, done more for the relief of a loathsome affliction, which rendered life almost intolerable, than all who had preceded them. An operation which heretofore had resulted in only occasional and, as might be said, accidental success, now in the hands of such men as I have named, with Emmet and Simon, and many others, scarcely ever fails.

HEALING OF ULCERS BY TRANSPLANTATION.

Before leaving the subject of plastic surgery, I must call your attention to a truly wonderful discovery which has just been made by a young surgeon, M. Reverdin, interne at the Hospital La Charilé in Paris. There are certain ulcers and wounds of integument which, solely on account of their extent, have hitherto been considered incurable. To illustrate by an example: If the whole of the skin were stripped from the arm, no effort of nature or skill of surgery, however long continued, could ever succeed in restoring the tegumentary covering. At least such has been the statement until to-day, and for the following reasons: First, because new skin never forms except from the margins of the old; and second, new skin can never be projected from the old beyond a few inches, perhaps two or three at most. But many examples are presented in surgery, in which the integument is destroyed by burns or by machinery to such an extent that repair, limited by these invariable laws, utterly fails to complete the restoration, and great deformity from contraction, a perpetual ulcer, or amputation, have been the only alternatives.

I must be permitted to mention my own humble contributions to the relief of this condition, made in the same direction as that of M. Reverdin, but which his more brilliant discovery has completely eclipsed. By a successful operation upon a patient at the hospital of the sisters of charity in Buffalo, in 1854, I demonstrated that a comparatively small piece of skin, perhaps three inches square, taken from one leg and transplanted to an open ulcer upon the opposite leg, which was eight inches square, would, after becoming attached, grow and increase in size by the projection of new skin from its margins, until the whole ulcer was closed in. This operation has been repeated many times by myself and others since the date of my first experiment, and with similar results. But listen now to what M. Reverdin has done. He has taken a piece of skin not larger than a lentil seed from the arm of a patient, and inserting it in the midst of the raw, granulating flesh of an ulcer, it has become the center from which new skin has been formed and has extended on all sides; and by making several of these minute insertions, the whole sore has become speedily cicatrized.

Assisted by my house surgeon, Dr. Williams, I have repeated these operations at the Charity Hospital already more than fifty times, the results of which experiments have been published in The New York Medical Gazette. My first patient refused to submit to the operation, fearing that the excision of the piece of skin would be painful; but having cut a small piece from my own arm, he permitted me to insert it into his open wound. This trivial operation, made in the presence of a large number of others suffering from chronic ulcers, gave them an assurance that it was almost painless and bloodless, and no further difficulty was experienced in prosecuting the experiments. We had but six successes from this large number of transplantations, but the principal causes of failure have been ascertained, and will be avoided hereafter. What is most remarkable in this thing is that the minute piece thus implanted seems to fall off in a few days; but at the point where it rested, after the lapse of a week or two more, a small white spot is seen gradually coming into view like a cloud upon a clear sky. The original and parent structure disappears, but a cell or seed is found to have been deposited capable of indefinite growth and development. The precise law which governs this curious process we do not pretend to have ascertained; but having discovered the fact, and availed ourselves of it in the cure of our unfortunate patients, we can afford to wait for the explanation.

DENTISTRY.

Dentistry, constituting, properly, one of the departments of surgery, has fallen of late almost exclusively into the hands of specialists; and most of my auditors have probably had sufficient practical acquaintance with this specialty to form their own opinion of its value and present rank; but it is doubtful whether any of the present generation have any proper idea of its condition fifty, or even thirty or forty years ago, when extracting teeth by that rude instrument called the "turnkey," and replacing those which were lost with teeth obtained from the dissecting room, or with such as had been filed down with great labor from pieces of ivory, constituted nearly the whole of the art. To the industry, talent and ingenuity of those gentlemen who represent dentistry to-day, we are indebted for pretty much all those wonderfully artistic results which are now obtained, and by which youth and beauty are miraculously restored.

Ophthalmic Surgery.

The eye—that window of the soul, from which all within looks out, and all without looks in—has also its debt of obligation to the industry and skill of those who, in modern times, have studied its ingenious mechanism, and have learned better how to repair its defects. The Germans have had by far the greater share in the improvement of ophthalmic surgery. Removal of cataracts by the needle and knife has been practiced for many centuries, but the operation is much more successful now than formerly. Baron Wenzel, I think it was, who said he "had destroyed a hatful of eyes before he learned how to extract." It was not, however, the fault of the operator so much as of the method and instruments he employed, that his experience proved so costly to his patients. The operation, no doubt, demands a certain tact and delicacy of manipulation, which is only acquired by practice; but the surgeon who should venture to make Baron Wenzel's confession now could scarcely expect forgiveness. One of the most destructive affections of the eye, glaucoma, was, until a very recent date, scarcely understood at all. Obscure and insidious in its origin and progress, surgeons were unable to establish any rational theory as to its cause or character. By the aid of the ophthalmoscope, invented by Helmholtz, in 1851, the interior of the eye was explored; and in 1856 the genius of Von Graefe of Berlin was able to confer an everlasting benefit upon mankind, by the discovery of an operation which, when performed early, has proved to be an almost certain remedy for this hitherto intractable malady. The operation termed "iridectomy," is as simple and easy of execution, also, as it is certain in its results.

Allusion has been made incidentally to the discovery of the ophthalmoscope in 1851, by which the interior of the eye may be illuminated, and its pathological changes brought under direct observation. Since its introduction many errors have been corrected, and many original discoveries made. In regard to almost every disease affecting the interior of this organ, our views have undergone some changes. Glaucoma is now for the first time understood after so many centuries of anxious inquiry; but equally has the obscurity been removed from those various affections of the retina until now only known under the term of amaurosis. The remedies for the several forms of this latter affection have not followed so speedily as in the case of glaucoma, but in our improved therapeutics we have an earnest for the future. We therefore wait patiently, and not without hope.

"SCIENTIFIC TOYS."

It is proper in this connection to allude to other instruments recently invented for examining the interior of various organs of the body, which may be denominated artificial aids to the senses, but most or all of which have, by those unacquainted with their practical value, been regarded as mere scientific toys. The rhinoscope illumines and exposes to view the interior of the nose; the auriscope accomplishes the same for the ear; the laryngoscope, for which we are indebted especially to Turck and Czermak of Vienna, who perfected the apparatus about the year 1857, enables us to see the interior of the larynx, and to study the motions of the vocal chords. The trachea and bronchiæ, even, are easily brought into view; and we literally look into the chest beneath the ribs. Guided by the laryngoscope to the exact seat of an intra-laryngeal tumor, we have been able to cut upon it with precision and effect its removal.

The stethoscope, invented by Laennec of France, and perfected by Camman of this city, has revolutionized the study of diseases of the chest. With the aid of this instrument, the expert stethoscopist has recognized and recorded every pulsation of the heart and every murmur of respiration, with a refinement equal to written music. Nor is it less useful in its application to surgery; in the diagnosis and location of aneurisms; in guiding the surgeon to the regions in which it is safe to open the chest for the removal or collections of pus and other fluids; and in many other ways, which time will not permit me to enumerate.

TENOTOMY—(CLUB-FOOT, SQUINT EYE, ETC.)

In 1834, we received intelligence that Stromeyer, a distinguished German surgeon, had made and witnessed six successful operations for club-foot, by subcutaneous sections of the tendo-achillis; and not long after followed the astounding news that Guerin of Paris, in the case of a patient whose body and limbs were greatly distorted by contractions of the muscles, had divided forty tendons with the effect of immediate restoration of form and a speedy restoration of function. Division of tendons had always been considered grave accidents, and surgeons had taught that tendons must never be cut, except when the necessity was urgent. A serious inflammation was liable to follow wounds of the tendons, and when divided they were almost certain never to unite. Stromeyer discovered that by dividing the tendon subcutaneously, and not where it was inclosed by a synovial sheath, no inflammation usually resulted, and reunion of the divided ends invariably took place. Mütter of Philadelphia, and Detmold of this city, were the first on this side of the Atlantic who acquired distinction as tenotomists.

Only five years later, in 1839, Dieffenbach, another celebrated German surgeon, made a successful operation for what is known in popular language as "squint eye," by dividing one of the six small muscles which rotate the ball. The announcement of Stromeyer's operation, only a few years before, had been received with great enthusiasm in all parts of the world; but the operation of Dieffenbach for straightening crooked eyes appealed more directly to the popular sentiment; its results were more uniform and immediate, and were obtained alike in the old and young. Consequently it was hailed with still greater enthusiasm, and the applause has been more prolonged. Soon after its announcement, I had an opportunity of making the operation upon a young man, before a large class of medical students gathered in the operating room, and when, after a brief and almost bloodless operation, the lad stood up, with his eye restored to its natural position, the students made the old building ring with their stamping and clapping, and shouts of applause. To-day young medical students witness the operation, which they have already seen performed fifty times or more, in silence. Familiarity has bred contempt. But many a young man, and many a young woman whose oblique and sinister look has in childhood subjected them to thoughtless jests, and, perhaps, in later years has turned away the heart of a lover, has had reason to be grateful to the skillful operator, and to the great German surgeon who first devised this method of relief.

Dislocation of the Hip.

By a process somewhat similar to that by which confessions were extorted in the Spanish inquisition, surgeons were accustomed until recently to attempt the reduction of dislocations of the hip. The muscles which surround this joint are the largest and most powerful of all the muscles of the body; and when, by an unfortunate accident, the thigh bone was thrown from its socket, the patient was first bled so as to lessen the power and resistance of the muscles, and then pulleys were applied and extension made, until reduction was accomplished. In 1851, Dr. W. W. Reid of Rochester, N. Y., published an account of a new, simple, and effective method in which the reduction was accomplished by the hands of the surgeon alone, or by "manipulation" as it is termed, in contradisdiction to the old method in which force was employed. (It is true that this method had been occasionally practiced by surgeons before this date, but the principles which control the reduction had been unexplained, and it had passed into disuse or had been wholly forgotten.) While the patient is lying upon his back, the thigh and leg are lifted and carried through various motions of flexion, adduction, rotation, abduction, by which the head of the bone is disentangled from the muscles and the reduction effected without violence, without pain, and in many cases in a period of time not longer than I have occupied in this description. My first trial of this method, made upon a powerful young man whose thigh had been dislocated in a railroad accident, was undertaken with little or no expectation of success; and when, on completing the turns, as they had been carefully described by Dr. Reid, I found the limb reduced, I was amazed and confounded.

The simplicity of the process, compared with the fullness of its results, seemed hardly less marvelous than what Cato, the Roman censor, declared was frequently done in his day. Indeed, he had often reduced a dislocation, he affirms, by the repetition of the following words: "*In motor Daries, Dardaries, dissunapiter*, and it is reduced," adds the grave censor. But Cato accomplished the reduction only by the agency of those spiritual and unseen agencies which his mysterious abracadabra had evoked; while Dr. Reid achieved his apparently miraculous results himself, aided alone by a correct knowledge of anatomy. The miracles performed by Cato and his disciples have ceased, but those performed by Reid will be repeated as long as anatomy continues to be studied, and surgery to be prosecuted as a science.

OVARIOTOMY.

The first successful operation of ovariotomy was performed by Dr. Ephraim McDowell, of Kentucky, in December, 1809. The patient, a Mrs. Crawford, of Kentucky, then forty-seven years of age, recovered from this terrible operation so rapidly and completely that on the twenty-fifth day she started on her journey home, a distance of sixty-five miles. This operation consists in laying open the walls of the abdomen, and removing from the interior cavity a dropsical or otherwise diseased ovary, which in many cases have been found on removal to weigh thirty, forty or more pounds. Although ovariotomy has now been performed in this country and in Europe many hundreds of times, and with a degree of success which was not at first anticipated, yet its expediency is still questioned by some excellent surgeons in all parts of the world. The grounds for this distrust I cannot stop to consider; but it is certain that the operation is growing in favor, perhaps in proportion as the rules which should govern in the selection of cases, in deciding upon the period and circumstances most appropriate for an operation, and in the methods of procedure, are better understood, by which the chances of success are becoming more assured.

It seems proper also to speak of the later methods employed for crushing and removing calculi from the bladder as triumphs, or at least as marked improvements in surgery. Lithotrity is the substitute for lithotomy, or the cutting operation, which latter has been so long and so successfully practiced by surgeons. Operators are somewhat divided as to the relative merits of lithotomy and lithotrity; but all are agreed that neither method is of universal application, and that consequently both operations need to be retained. Lithotomy has undergone many changes and experienced many improvements since it was first practiced; but lithotrity was very little practiced until about the beginning of the present century; and to appreciate the improvements which have been made we need only compare the rude, complicated and cumberous instruments employed by Civiale and others forty years ago, with the simple, light and mechanically perfect instruments to-day used by Thompson, Fergusson and others. Within the last year, Dr. Moore, of Rochester, has contrived a most ingenious lithotrite, which promises to excel anything yet invented for rapidity and certainty of execution.

OTHER TRIUMPHS.

There are many other great and essential improvements, as well as entirely new and successful surgical operations, to which it would be impossible even to allude in the time allotted to a single lecture. Some of them, without explanation, would appear to you trivial, and others might challenge a doubt as to their propriety; but to the experienced surgeon they indicate substantial progress in the relief of human suffering. Thus, for example, the employment of adhesive plasters as a means of extension, first suggested by Dr. Josiah Crosby, of Hanover, N. H., has almost revolutionized the treatment of fractures of the thigh; and the porcelain probe invented by Nélaton has proved of inestimable service in the detection and removal of leaden balls lodged in the various parts of the body. Lister's method of treating wounds by carbolic acid and exclusion of air is to-day doing great service upon the battle-fields of France. The spleen, the kidney and the uterus have been extirpated safely; but these are operations for whose justification there must be found special and extraordinary reasons. Barton, of Philadelphia, some years ago, devised and practiced successfully a new operation for the formation of a false joint in anchylosis of the hip and knee; and to-day we are waiting with interest to determine the value of certain ingenious experiments with the silver ligature, made by Dr. Howard, of this city.

ANÆSTHETICS.

Before I close, ladies and gentlemen, I must not omit to remind you that it is now just twenty-six years since the discovery of a method by which surgical operations could be made without causing pain, an end which was attained only after many centuries of inquiry and experiment. We find evidence that this subject occupied the attention of surgeons from the commencement of the Christian era. The Roman physicians, in the first century, speak of the use of the wine of madragore for the purpose of inducing sleep and insensibility when the knife or actual cautery were to be employed; and Pliny observes that some persons are put to sleep by the smell of madragore. Shakspeare more than once alludes to the sleep and inebriation which it induces. Hemlock, hemp, opium and alcohol have been suggested, and at one time or another employed with unequal but rarely satisfactorily results. Mesmerism and magnetism have had their pretended successes. Pressure and cold have been applied directly to the parts to be operated upon. Juvet recommended a ligature to be placed above the point where an amputation was to be made. Moore preferred pressure more directly upon the nervous trunks supplying the diseased member. Richerand advised dipping the cutting instruments into hot water. Others, with the same purpose, have immersed the knife in sweet oil.

Weary of these fruitless experiments, surgeons had at length settled into the conviction that a sharp knife, with a light and dexterous hand, or, according to the old maxim, to cut "*tuto, cito, et* *jucunde*," were the only means we could ever hope to possses for alleviating the pains of an operation. In the edition of "Velpeau's Surgery," translated by Townsend of this city, and ready for the press in December, 1844, occur the following passages: "To avoid pain in operation is a chimera that we can no longer pursue in our time. A cutting instrument and pain, in operative surgery, are two words which are never presented separately to the mind of the patient, but in an association which he must of necessity admit." * * * "It is to the hand of the operator and the quality of the bistoury that we must look to obtain the desired result. Let the hand be light and steady, and the bistoury smooth and well sharpened, and give with the first stroke the whole length and depth that the incision should have if you can do so without danger; then act with promptitude and without hesitation, * * * and you will have no other pains to encounter than those which are inherent in the operation, and which nothing can separate from it." These words, my auditors, were the best legacy of comfort the most accomplished surgeon of the world could give to us, to avoid the pain of an operation, in December, 1844. The same month, in which these words were uttered, Dr. Horace Wells, a dentist, of Hartford, Conn., made his first successful trials with nitrous oxyd, and demonstrated that to avoid pain in surgical operations had ceased to be a chimera. There is, as I regard it, another singular coincidence connected with this discovery. The nervous aura which establishes an intercommunication of intelligence and sensation between the various members of the body, has been supposed to be identical with electricity. Anæsthetics, in their power of causing temporary insensibility, indicate perhaps a control over the nervous electrical currents. In May, 1844, five months before the discovery of the anæsthetic properties of nitrous oxyd, the first message was carried over the telegraphic wire constructed by Morse, from Washington to Baltimore, in these words, very appropriately chosen by Miss Ellsworth of Hartford, Conn., "What hath God wrought!"

Electric cords had been laid which were ultimately to bind all the nations of the earth in one united system, establishing a universal and coincident sympathy throughout the human family. In the same year the electric cords of the individual man were in like manner brought into subjection, so that hereafter sensation, intelligence, and all communication between the different portions of the body could be interrupted or established at pleasure. The electric currents of the body and of the world were henceforth, by divine permission, under the dominion of man. From the same humble New England town a voice has answered to voice, as if in choral anthem, "What hath God wrought!"

> "From harmony to harmony
> Through all the compass of the notes it ran,
> The diapason closing full in man."

The discovery of the anæsthetic properties of nitrous oxyd was followed in 1846 by the discovery of a similar property in sulphuric ether, by Drs. Jackson and Morton, of Boston. In 1847, Dr. Simpson of Edinburgh discovered that chloroform was a much more powerful anæsthetic than either nitrous oxyd or ether, but experience has shown that it is far less safe.

Permit me now to read to you an account of the reception of the news in Great Britian, that there had been discovered in America a safe and certain means of preventing pain in operations, given to the class of medical students in the University of Edinburgh in 1848, by James Miller, the Professor of Surgery:

"On the 23d of December, 1846, it was my privilege to read a letter in this class room from the late Mr. Liston, announcing in enthusiastic terms that a new light had burst on surgery, and that on mankind a large boon had been conferred. The letter conveyed the writer's earliest and most lively impressions of a subject as startling as it was new. And there was a large-hearted generosity about it that was sure to meet with a suitable response in all right-beating breasts. The subject was anæsthesia, and its first sound had come from across the Atlantic. It fell on no dull or idle ears. It was taken up, tried, and speedily reechoed, and in a few days it filled the island. Mr. Liston struck the key-note and a pealing note it was. We followed here with less power perhaps, but we hope in tune, well pleased to find that, high as the note first seemed to be, it was still within the reach of an ordinary compass. The profession were surprised, excited, charmed in the mass, and more especially those on the junior side of the grand climacteric." * * * But some of the older gentlemen were distrustful; "they had quite made up their minds that pain was a necessary evil and must be endured;" * * "on, notwithstanding, sped the movement." "The public, as was naturally to be expected, were greatly excited and rejoiced in the tidings. By some they were scolded for interfering; but to my mind they might as well have been reprehended for showing great and personal concern in the wars of the Indian Punjaub, repeal of the Corn laws, or any other of the large and pressing questions of public interest at the time. At first they seemed somewhat incredulous, as if it were too good news to be true. Soon all became satisfied of there being "something in it," on good hearsay evidence; and some had occular demonstration. Here, for example, a considerable number of our citizens sought admission to the operating theater of our hospital, and like the queen of old, they found it was a true report they had heard, but that one-half had not been told them.

"And this reminds me of one august visitant who at this time honored the institution with his presence, the great, the good, the singularly human Chalmers. No pruriency of sight-seeing brought him there. No man, it is well known, was ever more tender of eye as regards blood and pain. But he heard of humanity's boon and sought to know the truth; and it was one of the early triumphs of anæsthesia here to see that man of large and tender heart, witnessing a bloody and severe operation, with composure and serenity; feeling little because the patient felt not at all; and the little that he himself did feel far more than compensated by the thought that a brighter day for that suffering humanity, with which he so closely and continually sympathized, had at length dawned, and that, from henceforth, throughout the domain of surgery, injury and disease were shorn of half their terrors."

But lest you may think this picture of the reception of the news abroad has been overdrawn by one perhaps too sanguine and emotional to estimate novelties according to their actual and intrinsic value, I will take the liberty of quoting from Sanson, another English writer, who says: "No greater impression was ever made by any discovery;" and Sedillot, a French writer exclaims, with the ardor peculiar to his countrymen, speaking especially of chloroform: "Its marvelous powers of suspending pain transcends all that the imagination had ever conceived of the charms and enchantments of a bygone age." Mr. Erichsen, professor of clinical surgery, in the University College, London, speaks of the discovery as "one of the greatest boons ever conferred upon mankind;" and he adds: "To the Americans is undoubtedly due the honor of having established the practice of anæsthesia in surgery."

SCIENTIFIC LECTURE.—IV.

WATER.

By Charles F. Chandler, Ph. D.,
Professor of Analytical and Applied Chemistry in the School of Mines of Columbia College.

DELIVERED BEFORE THE AMERICAN INSTITUTE, AT THE ACADEMY OF MUSIC, JANUARY 20TH, 1871.

Composition of Water.

Water is the sole product of the combustion of hydrogen in oxygen or the atmosphere. The Hindoos and the Egyptians considered water the element from which all other bodies were formed. Among the Greeks the idea was maintained, that water was the first or fontal element; that from it all other bodies were formed; that even plants and animals owed their origin to it. Aristotle regarded water as one of four elements, and this idea was maintained for more than a thousand years, though the old idea that water was the primal element, seems to have been mingled with this idea, for it was supposed that those four elements, fire, earth, air and water were mutually convertible. Heat converted water into invisible air; repeated evaporation, they said, converted water into earth, so that there seems to have been an original idea, that water was the only sole element.

Lavoisier, in 1770, tested experimentally the question of the conversion of water into earth. It had long been known that when water was placed in a glass retort or alembic, and distilled, there remained behind a small quantity of earthy matter, and if the water was returned to the alembic and distilled again, the quantity of earthy matter increased, and it continued to increase as often as the water was distilled from it. It was supposed, therefore, that the water was gradually converted into earth. Lavoisier distilled three pounds of water again and again, in an alembic provided with a condenser, the whole apparatus being hermetically sealed, that not a particle of water should be lost. At the close of the experiment, he found that while the quantity of water had not diminished in the least, he had a residue of twenty grains of earthy matter in the alembic. As the water had not diminished, he justly concluded that it had not come from the water; it must then have been derived from the alembic itself. On cleansing the alembic and condenser, and weighing them, it was found that they had lost seventeen grains. Seventeen grains of the earthy matter had, therefore, been produced by the action of the boiling water on the glass. The remaining four grains were attributed by Lavoisier to the natural impurities of the water. Scheele, the great Swedish chemist, tested the same question, and not only proved that the earthy matter was derived from the glass, but analyzed it and found it to consist of the same constituents, potash, lime, and silica. Dalberg repeated the experiment in a silver vessel and obtained no earthy matter. So the conversion of water into earth was proved to be a fallacy due to the action of the water upon the glass vessel.

Until 1781, water was considered an element. Hydrogen had been known in the fifteenth century; had been prepared by the action of dilute sulphuric acid upon metallic iron, and was supposed to be *phlogiston.*

Oxygen was discovered in 1774 by Scheele and Priestley; but it was not till 1781 that Cavendish proved water to be composed of oxygen and hydrogen; proved it to be a compound, instead of an element. He identified its constituents as the hydrogen long known and the oxygen which had been discovered a few years previous. The efforts of several of the most distinguished chemists were at once directed to the question of determining the proportions in which these elements were combined. Lavoisier investigated this subject, and made repeated analyses, but failed to arrive at the true proportions. Humboldt and Gay Lussac investigated the question, and decided that water contained eight parts by weight of oxygen, and one part by weight of hydrogen. In 1772, nitrogen was discovered in the atmosphere; and in 1775, Lavoisier proved that the air was a mixture of oxygen and nitrogen. So it is just 100 years since the great fundamental discoveries were made upon which chemistry rests, and all the sciences, geology, mineralogy, physiology, etc., which are based upon it. The discovery of the composition of the atmosphere and of water may be truly said to be the great fundamental discoveries upon which the whole system is based. They constitute the starting point in our system; and Lavoisier's experiment stands out in bold relief as one of the first experiments upon record in which the chemical balance was introduced; in which quantities were examined as well as qualities. The experiments of the alchemists, by which a large fund of fact had been accumulated, were all directed to the qualities of the products; but Lavoisier, when he introduced the balance, made the first great step in advance, and in this way decided the fate of the old phlogiston theory, and the many other theories which were based upon error.

The composition of water is beautifully shown by the decomposing action of the voltaic current. I have here a voltaic battery, the wires from which terminate in plates of platinum. In this glass jar is water, which has been colored pink to make it visible, and has been acidulated to make it a good conductor of electricity. The voltaic current decomposes the water, and the constituent gases are set free at the surfaces of the platinum plates, from which they ascend in bubbles and displace the water in the two vertical tubes. Notice that the hydrogen from the negative pole occupies twice the volume of the oxygen from the positive pole, but the oxygen being sixteen times heavier than hydrogen, this small quantity of oxygen weighs eight times as much as double the volume of hydrogen. I can show you the properties of these two gases by a simple experiment. Hydrogen is combustible. We have merely to cause it to escape by depressing this cylinder which contains it in a vessel of water, and apply a flame to indicate this fact. Now you see that the hydrogen is burning with a pale bluish flame. Thus we have a combustible gas produced by the decomposition of water. Oxygen is not combustible, but it is a supporter of combustion. We will now transfer our cylinder, which contains the gas liberated from the positive pole of the battery, to a vessel of water, and depress it, to cause the gas to escape from the cock which I will now open. You see the spark on my taper has been kindled into flame by the gas, and that as often as I extinguish the flame and bring the spark into the gas, it lights again.

You have now seen that the voltaic current decomposes water, setting free its component gases; the combustible hydrogen, and the supporter of combustion, oxygen.

OXYGEN.

Oxygen is the most abundant element in nature. Almost every other element on the earth's crust occurs combined with oxygen, and really the earth's crust is composed of the ashes produced by the combustion of the other elements. Still there is an excess of oxygen which we find in our atmosphere. You see the changed character of the flame of the taper when introduced into this gas. Now I propose to burn a little phosphorus in one of these jars and some magnesium in another, simply to illustrate the character of oxygen in supporting combustion. In the atmosphere we have four volumes of nitrogen to every volume of oxygen, and the consequence is, that the combustion is retarded by this inert nitrogen. The nitrogen takes no part apparently in the chemical changes produced by the atmosphere. The rapidity of the combustion depends greatly upon the rapidity with which the oxygen comes in contact with the combustible body. By removing the nitrogen, or rather by preparing an atmosphere free from nitrogen we simply hasten the combustion. We will now introduce the burning phosphorus into the jar of oxygen. You see how wonderfully the combustion is intensified by the pure oxygen. The globe is now apparently filled with fire which it pains the eyes to behold. The white cloud which now fills the globe is phosphoric acid in the form of solid white particles, which will ultimately settle to the bottom, forming a layer like snow. This is the ashes of the phosphorus. When your eyes have recovered somewhat from the effect of the dazzling light upon them, I will set fire to this piece of magnesium and introduce it into a globe of oxygen. Now watch the burning metal, the light is whiter and more brilliant even than that produced by the phosphorus. This is the metal which exists in Epsom salt, and the white product or ash is magnesia.

The affinity of oxygen for phosphorus is so great that we may cause them to unite under water. In this conical glass we have a piece of phosphorus; on pouring this hot water upon it, it is melted, and now, on introducing a jet of oxygen you see we have the phosphorus actually burning under water; the phosphoric acid is dissolved by the water as fast as it is formed, so it is not visible as it was when we burned the phosphorus in dry oxygen gas. Many substances have the power to decompose water by robbing it of its oxygen, setting the hydrogen free. This metal potassium which I now project upon the surfarce of the water in the jar, rapidly appropriates the oxygen of the water forming potassa which dissolves, the hydrogen escapes and you see the heat of the reaction has set it on fire and it burns with a beautiful violet flame. The color of the flame is due to a portion of the potassium which has vaporized. The water is thus actually set on fire by the potassium.

By placing a bit of this metal on the priming of a cannon, and applying an icicle we fire the piece, I will spare you the shock of the explosion, by omitting the experiment. But the principle will be as well shown when I apply this icicle to the wick of my spirit lamp, on which I have placed a bit of potassium. For, see, it lights at once. We have, therefore, set an icicle on fire, and thus lighted the lamp.

HYDROGEN.

In this jar we have the other constituent of water, hydrogen. As I hold the jar with its opening downward it will not readily escape, as it is the lightest substance known, being only one-fourteenth as heavy as air. Now, on bringing the burning taper near the mouth of the jar, you see the hydrogen burns where it is in contact with the air, while the taper is extinguished. As I withdraw the taper, it is relighted on passing through the flame of hydrogen.

This experiment illustrates the combustibility of the hydrogen, and its inability to support the combustion of the taper. The terms *combustible* and *supporter of combustion* are merely relative; in an atmosphere of hydrogen the oxygen would be combustible and the hydrogen the supporter, while the taper would be incombustible.

I have here a little apparatus containing zinc and dilute sulphuric acid, from which hydrogen is being evolved. I propose simply to burn a little of the hydrogen beneath this globe to form water by the combustion. In a few moments you will see the jar covered with moisture, which is water produced by the combustion. In fact, a spirit lamp will produce water in exactly the same manner, every substance that contains hydrogen produces water when it is burned in the atmosphere. You see, the jar has become dimmed and damp with the moisture, which is the result of this combustion of the hydrogen.

PROPERTIES OF WATER.

Water is the most important and the most remarkable of all our chemical compounds. It covers three-quarters of the earth's surface, in the form of ocean, lake and river, and in the higher latitudes snow, ice, glacier and iceberg. Rising in the form of vapor it produces by condensation clouds, fog, mist, rain and snow. In the vegetable kingdom it is ever present, varying in quantity from ninety-nine per cent down to fifteen or twenty. Dry wood contains twenty per cent of moisture. Animals consist largely of water. An average man, weighing 150 pounds, contains about 116 pounds of water. The rocks contain it; some hold it in large quantity. Gypsum contains twenty per cent of water, and even rocks, which are not hydrated compounds, contain it in moderate quantity, a fraction of a per cent. It is a bad *conductor* of heat, but has a great *capacity* for *heat*. A cubic mile of water in cooling one degree warms over 3,000 cubic miles of air a like amount. And when water freezes it evolves a large amount of heat. A cubic yard of ice, in the process of melting, absorbs the heat which it gives out in freezing; it takes up enough heat to change the temperature of 21,000 cubic yards of air from 52° to 32° Fahrenheit. On account of this great capacity for heat, this absorption of heat when ice melts and this evolution of heat when it freezes, water becomes the great regulator of the temperature of the earth.

Water combines with other substances, and at times plays the part of an acid with strong bases. When water is thrown upon quicklime we have produced the hydrate of lime, and the water plays the part of an acid, while in oil of vitriol we have water playing the part of a base.

A second degree of affinity of water for other substances is illustrated when substances crystallize from aqueous solutions. They lock up a certain quantity of water which we call *water of crystallization*. Such is the case with alum, borax, and carbonate of soda. A still weaker affinity is manifested in the process of solution. All substances are soluble in water to a greater or less degree. Solids and gases are taken up by it. Some of our ordinary reagents are simply solutions of gas in water, as ammonia, hydrochloric acid, and hydrosulphuric acid. Besides these three forms of combination, where water plays the part of an acid or a base, is secreted in crystals or acts as a solvent, we have other and weaker forms of combination. All solid substances contain more or less water. Rocks, when exposed to a temperature of 212°, lose in weight on account of the escape of the moisture which they contained. This is called *hydroscopic moisture.*

NATURAL WATERS.

Water being a great solvent, dissolves to some extent, whatever it comes in contact with. Even atmospheric waters, the rain and melted snow are not pure. Rain, as it falls through the air, washes out the solid particles of dust, and the germs of animals and plants. And in addition to these it dissolves the oxygen, the nitrogen, and carbonic acid of the atmosphere, the oxygen to a greater extent than nitrogen. Air which is dissolved in water is much richer in oxygen than ordinary atmospheric air. This seems to be a special provision of nature for the fishes. They extract the small quantity of oxygen which is dissolved by the water from the air. The quantity is small. Twenty-five cubic feet of water take up only a cubic foot of oxygen. But this quantity is sufficient for the maintenance of life in the fishes; their gills enable them to absorb it, and they die without it.

Water which is collected from roofs in the city is never pure. It contains gases which are only develped in cities, sulphur compounds, products of the combustion of coal, and animal matter. After thunder storms, the rain water is always found to contain minute quantities of nitric acid produced by the electric sparks which cause the oxygen and nitrogen to unite.

SPRING WATERS.

Terrestrial waters are always impure. Rain falling upon the earth's surface is absorbed by the porous soil, and the material of which the soil is composed, being to a greater or less extent soluble, the water becomes contaminated with mineral matter. The character of spring water, therefore, depends upon the character of the soil through which it has passed before it issues as a spring. In New England, where the rocks are granitic, and the minerals, chiefly quartz, feldspar and mica, water is extremely pure. But in limestone countries where carbonate of lime and magnesia abound, we find the spring waters largely contaminated with these substances. These carbonates are rendered much more soluble in water by the carbonic acid present, which forms bicarbonates with them.

In this jar is some lime-water; a clear solution of lime. The carbonic acid water, which I now add from the syphon bottle, produces carbonate of lime, which makes the liquid milky; but you see it now disappears on the further addition of carbonic acid. The clear liquid now contains the bicarbonate of lime. To such solutions of bicarbonate of lime are due many curious phenomena in nature. Where they trickle down from the roofs of caves, the evaporation of a portion of the carbonic acid causes the separation of an equivalent quantity of carbonate of lime. Each drop, as it hangs for a moment and then falls, leaves behind a thin pelicle of solid spar, and finally, in years of dripping, a stalactite is formed. Where the drops strike the floor of the cave, corresponding stalagmites gradually spring up, often meeting the stalactites at last, and forming columns of glistening stone. Sometimes where the water falls from a crevice, a series or row of columns is produced, which finally becomes a solid wall or partition of spar.

On boiling solutions of bicarbonate of lime and magnesia, the excess of carbonic acid is expelled, and the carbonates having no longer a solvent are precipitated. In this way incrustations are formed in teakettles and steam boilers.

Spring water is generally very clear, although it may be quite impure. It holds its impurities in solution. The soil through which it has passed, although it has conferred upon it its impurities, has at the same time filtered it, and thus rendered it clear and sparkling. As it comes from below the surface, it is generally cool. For these reasons spring water has always been highly prized. Wells which are dug down below the surface, are supplied partly by springs and partly by local drainage. The water may be very pure, or, if the surrounding soil is calcareous or charged with the refuse animal matter of neighboring dwellings, it will be very seriously contaminated with impurities.

ARTESIAN WELLS.

Occasionally wells are sunk to great depths by boring. Such wells are called artesian wells, from the district in France where they were first bored.

The earth's crust consists in many localities of strata of gravel, sand or clay, resting upon sandstones, limestones or shales. In many cases these strata are in basins, and their edges often come to the surface at the margin of the basins. Some of these strata, which are porous, constitute reservoirs of water, and by boring down to them this water is reached. It may rise above the surface and overflow if the strata rise elsewhere to higher levels; otherwise it must be pumped. Often the pressure of gases forces the water above the surface. At Grenelle, near Paris, an artesian well was bored down 1,600 feet, or nearly one-third of a mile. The water rose eighty feet above the surface, and flowed at the rate of ninety cubic feet per minute. Coming from so great a depth, it is very warm, and must be stored in a reservoir to cool. At Rochefort, in France, is a well 2,676 feet deep, or more than half a mile. This is the deepest well in Europe.

Some of the deepest artesian wells have been put down in this country. At Louisville, Ky., there is one 2,086 feet deep, the water of which has a temperature of 82° Fahrenheit. But instead of being suitable for domestic purposes, the water proved to be heavily charged with chemical compounds, which give it a medicinal value. At Charleston, S. C., there is a well 1,250 feet deep, yielding similar mineral water. At Columbus, Ohio, an artesian well, at the depth of 180 feet, yielded sulphur water; but it proved to be hard water. At the depth of 675 feet salt water was obtained. As fresh water was required, the well was pushed down a half a mile, or 2,575 feet; but no water was obtained of satisfactory quality. At St. Louis a well was bored to the depth of 3,881 feet, or two-thirds of a mile; but no water of any consequence was obtained, and the well is a failure.

In many instances water which rises in artesian wells comes from great distances. At Tours, in France, the well is sometimes obstructed, and when the obstruction is removed, it is found that the leaves which come to the surface, and which caused the obstruction, do not grow within a hundred miles of Tours; showing that there is some subterranean communication by which the water, as well as the leaves, is brought from a distance.

NATURE OF THE IMPURITIES OF SPRING WATER.

Ordinary spring waters (fresh waters, as they are generally called) contain salts of the alkalies and alkaline earths: Chlorides, sulphates, and bicarbonates of potassa, soda, lime and magnesia. The most common salts are the chlorides of potassium and sodium, the sulphates of soda and lime, and the bicarbonates of lime and magnesia.

Besides these alkaline and earthy salts, we almost invariably find silica, the substance of quartz, to the amount of a grain or less in a gallon. In wells which receive drainage waters, in the neighborhood of dwellings, we generally find nitrates, nitrites and ammonia salts, derived from decomposing animal matters in the soil.

I have here a sample of impure well water, in which you shall see some of the more common impurities. Carbonic acid is shown in this jar by the addition of lime-water, which forms carbonate of lime, visible to you now as a milky precipitate. Lime is apparent to you as a white precipitate, produced by the oxalate of ammonia, which I am now adding to the second jar of the water. Sulphates are shown by the white precipitate which will appear on the addition of hydrochloric acid and chloride of barium to this third jar. You see it forming now. Chlorides, common salt, etc., are now apparent in this jar, to which I have just added nitric acid and nitrate of silver.

There is a popular idea, originated by some itinerant temperance lecturer who pretended to analyze liquors, that chemical analyses are made with the aid of a machine, into which the liquid to be analyzed is poured, and from which on turning a crank the constituents flow successively. The lecturer referred to, employed such a machine in analyzing wines and liquors to terrify his audience, showing the logwood, fusil oil, strychnine, etc., which he supposed to be used in compounding them. You see, however, that reagents are employed to detect and separate the different constituents of the water. No machine will answer the purpose. Magnesia cannot be detected in the presence of lime; but I have here a sample of this water, from which the lime has been removed, and now on the addition of phosphate of soda you see the white precipitate of magnesia.

You have now seen me detect some of the common constituents of spring water. These reactions are produced by almost all spring waters; but their intensity varies with the quantities of the impurities.

HARD AND SOFT WATERS.

Lime salts in water are the cause of what is called *hardness*. They decompose the soap used in washing, forming a flocculent insoluble compound, and destroying its detergent properties. In Glascow the saving to the people in soap, due to the introduction of the pure water of Loch Katrine, in place of the hard well waters previously used, is said to amount to $180,000 per annum.

You see before me two tall jars of water. One water is pure and soft; the other contains much lime and is hard. I will add to each a solution of soap in alcohol. You see now that on shaking this jar a fine froth or soap suds is produced. This is the soft water. Now I will shake the other jar, and you see we get no suds; but the liquid becomes white and milky. The lime has destroyed the soap. Soap is, therefore, an excellent reagent for testing water; a fact which is well known, though few but chemists understand that it indicates the lime compounds only.

As bicarbonate of lime is destroyed by boiling, with the formation of insoluble carbonate of lime, which does not act on soap, it is said to produce *temporary hardness*, while sulphate of lime, which is not affected by boiling, produces permanent hardness.

ORGANIC MATTER.

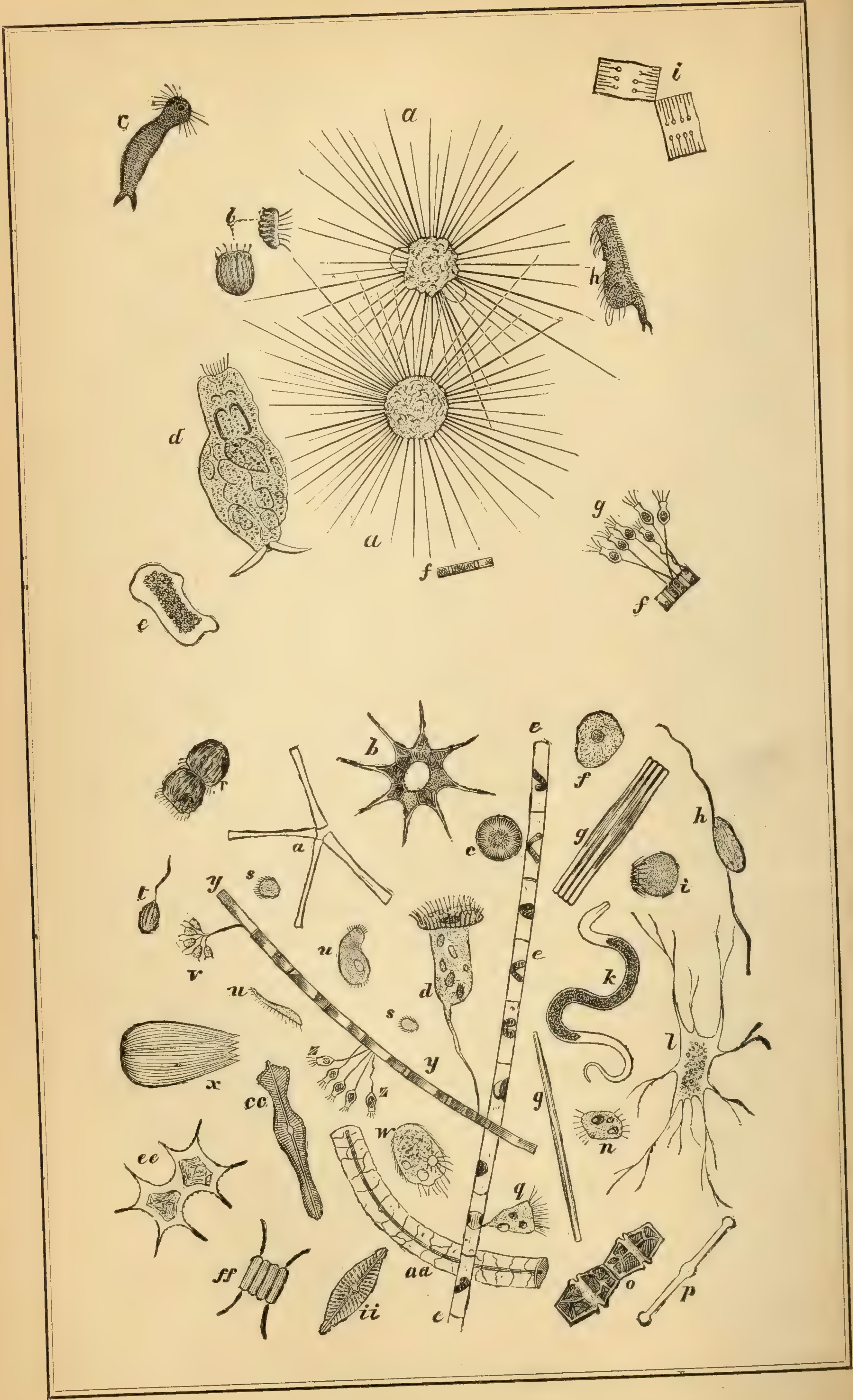
Another impurity which is always present in water, but whose exact chemical character has not been fully determined, is organic matter. This is undoubtedly a collective term for a great many different substances derived from decomposing vegetable and animal matters. I will show you a test which is often used for the detection of organic matter. It is the permanganate of potassa. You notice the beautiful pink color which is produced as I add a few drops of this reagent to this jar of water. But you see the color gradually fades away. This is because the organic matter takes oxygen from the permanganate, destroying it, and undergoing oxydation itself. The quantity of permanganate the water is capable of bleaching is a rough index of the proportion of organic matter present. A little time is required for the organic matter to bleach the permanganate; the sample of water before you received an addition of organic matter for the occasion, that you might not be obliged to wait long to see the color disappear. As the permanganate destroys the organic matter it is often used to purify impure waters, organic matters being the most objectionable impurities which occur in natural waters.

POND, LAKE AND RIVER WATERS.

Pond, lake and river waters are generally purer than spring water, for the reason that while those bodies of water receive the waters of springs, they also receive a considerable quantity of water which has simply run *over* the surface of the earth. When a shower comes up, a portion of the water goes through the soil and issues as a spring; but a large portion of it runs over the soil, and goes into the lakes and rivers without taking with it much mineral matter. For this reason the waters of lakes and ponds are much purer than those of the springs in the same locality. One of the purest waters known is the water of the river Loka in Sweden, which contains only one-twentieth of a grain of impurities in a gallon. Rivers are more likely to be charged with *suspended impurities*, for the reason that their waters, which have not been filtered through the soil, carry with them a certain quantity of clay and organic matter. That is what we see in Potomac water; it has had no opportunity to settle, and has not been filtered out. When water flows into lakes and the sediment subsides, it becomes clear. But in streams where the water runs rapidly, it has no opportunity to settle, and becomes very muddy. The water of the Mississippi contains forty grains of mud per gallon; and it is estimated that this river carries 400,000,000 tons of sediment per annum into the Gulf of Mexico. The Ganges is said to carry down 6,368,000,000 cubic feet annually. This transportation of mud in suspension has produced large deposits at the mouths of these rivers. All of the State of Louisiana, and considerable portions of other States which border upon the lower Mississippi, have been formed by the deposition of these sediments brought from higher levels. This mud is rich in plant food, and the land which it produces is very fertile. The Mohawk flats are famous for their fertility; and the annual overflow of the Nile is the chief reliance of the poor Egyptians who cultivate the fields enriched by its sediments.

LIVING ORGANISMS IN WATER.

In addition to the soluble and suspended impurities already mentioned, we find living organisms in water, animals and plants. I will call your attention to the diagram, on which you will see some of the most common forms of the Croton and Ridgewood waters. It was prepared by Dr. William B. Lewis for the Metropolitan Board of Health: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Catalogue of the animal and vegetable objects found in the sediment of Croton water taken from the Central Park and Fifth avenue reservoirs during October, November and December, 1869:

a. Asterionella formosa, vegetable, a diatom, × 312.
b. Pediastrum simplex, vegetable, a desmid, × 200.
c. Cyclotella astræa, vegetable, a diatom, × 200.
d. Vorticella ——, an animalcule, × 312.
e. Conferva, vegetable, "green scum," × 40.
f. Epithelial cell, probably from manure during freshet, × 200.
g. Fragillaria capucina, vegetable, a diatom, × 200.
h. Heteromita ovata, an animalcule, × 500.
i. Halteria grandinella?, an animalcule, × 200.
k. Anguillula fluviatilis, a minute water-worm, × 312.
l. Amoeba porrecta, an animalcule, × 200.
n. Diophrys ——, an animalcule, × 200.
o. Didymoprium borreri, vegetable, a desmid, × 200.
p. Tabellaria fenistrata, vegetable, a diatom, × 312.
q. A free vorticella, an animalcule, × 200.
r. Coccudina costata, dividing, an animalcule, × 312.
s. Monas umbra, an animalcule, × 312.
t. Cyclidium abscissum, an animalcule, × 312.
u. Chilodon cucullulus, an animalcule, × 200.
v. Epistylis nutans, young, animalcules, × 200.
w. Paramecium ——, animalcule, × 200.
x. Difflugia striolata, the lorica or case, an animalcule, × 200.
y. Conferva, vegetable, "green scum," × 312.
z. Vorticella microstoma, an animalcule, × 200.
aa. Fragment of dyed wool, × 200.
cc. Gomphonema acuminatum, vegetable, a diatom, × 200.
ee. Arthrodesmus octocornis, vegetable, a desmid, × 312.
ff. Scenodesmus quadricauda, vegetable, a desmid, × 200.
ii. Navicula rhynchocephala, ? vegetable, a diatom, × 200.

Animal and vegetable objects found in the sediment of Ridgewood water, during the months of October, November, and December, 1869.

a. Actinophrys sol, an animalcule, × 200.
b. Coccudina costata, an animalcule, × 200.
c. Chætonotus squammatus, hairy-backed animalcule, × 200.
d. Notommata ——, a rotiferous animalcule, × 200.
e. Amœba guttula, an animalcule, × 200.
f. Melosira orichalcea, vegetable, a diatom, × 200.
g. Vorticella, microstoma, animalcules, × 200.
h. Chætonotus larus, hairy-backed animalcule, × 200.
i. Tabellario flocculosa, vegetable, a diatom, × 200.

I simply call your attention to one of them; this one lettered *l.*, the amœba porrecta. This is an animal which has no mouth, and yet contrives to put himself outside of his dinner by a very curious process. When a particle of food comes in his way, a little dimple is formed on his side, it does not matter which side. He thus very readily extemporises a stomach for his food. The soluble portion is absorbed, the insoluble portion is ejected, and the animal assumes his rotundity and goes on its way rejoicing. These animals, when magnified by the microscope are very frightful in appearance, but there is really no great objection to them. The plants even exercise a purifying influence on the water. It is stated by a celebrated English author, that the providential spread of the American weed Anachasis Alcinastrum, has saved thousands of lives by the purifying influence which it has exerted on the water courses in certain districts in England. These plants liberate oxygen which attacks poisonous dead organic matter and destroys it, thus purifying it of its most dangerous impurities.

THE OCEAN.

The ocean is the great and final receptacle of all waters which escape evaporation; and it consequently receives the mineral and other impurities which the rivers and smaller streams carry along in solution or suspension. From the surface of the ocean the water evaporates, rising into the atmosphere to fall again in the form of rain. Entering the soil, it again issues in the form of springs, with a fresh quantity of dissolved mineral matters, which it bears onward to the ocean. Thus, again and again, the rain drops have performed the voyage to the sea, each time laden with the little cargo of dissolved salts. In this manner the ocean has become very saline; it is the receptacle for the soluble matters which are washed out of the earth's crust.

Let me call your attention to an analysis of sea water, made by Von Bibra, which I have placed side by side with an analysis of the water of the Dead Sea, made by the Herepaths. The numbers represent grains in one U. S. gallon of 231 cubic inches.

	Atlantic Ocean.	Dead Sea.
Specific gravity................	1.0275	1.17205
Chloride of sodium.............	1671.34	6702.73
Chloride of potassium..........	....	682.63
Chloride of ammonium..........	....	3.35
Chloride of calcium.............	....	1376.75
Chloride of magnesium..........	199.66	4457.23
Chloride of aluminum	....	31.37
Chloride of iron.................	trace	1.50
Chloride of manganese..........	....	3.35
Bromide of sodium............ ..	31.16	156.53
Iodide of sodium	trace	trace
Sulphate of potassa.............	108.46	......

	Atlantic Ocean.	Dead Sea.
Sulphate of magnesia	34.99	......
Sulphate of lime	93.30	38.07
Phosphate of soda	trace	......
Carbonate of lime	trace	trace
Silver	trace	......
Copper	trace	......
Lead	trace	......
Silica	trace	trace
Organic matter	trace	34.59
Bitumen	....	trace
Total in one U. S. gallon	2138.91 grs.	13488.10 grs.
Per centage by weight	3.569	19.736
Water	96.431	83.264
	100.	100.
Weight of one gallon	59922. grs.	68352. grs.

You notice that chloride of sodium, common salt, is the predominating constituent. Next to this comes chloride of magnesium, then sulphate of potassa, sulphate of lime, sulphate of magnesia, etc.

As everything is soluble to a greater or less degree in water, we expect to find some of everything in the ocean.

An experiment was made on sea water to ascertain whether it contains any of the precious metals. It was found that a quantity of iron nails attached to the keel of a vessel separated from the water, a small quantity of silver, I forget how many tons of silver were estimated from this to exist in the ocean, but the per centage is so small that it would hardly pay to organize a stock company for its extraction.

The question arises, if these saline substances are being carried to the sea, is it not becoming much salter? A calculation has been made, by which it appears that about thirty-six cubic miles of water are poured into the ocean daily. But then this vast quantity of water is so small in comparison with the amount of water in the ocean, that it would take 30,000 years for all the water in the ocean to rise as vapor, fall as rain, and make the trip back to the ocean again.

INLAND SEAS.

Where evaporation is rapid, inland seas and lakes which drain considerable areas become even more salt than the ocean. The Dead sea and the Great Salt lake are examples. The Dead sea receives the waters of the Jordan. There are no outlets to this lake, and evaporation is rapid. The Jordan drains the surrounding country to a great extent, and pours its waters into the sea. By evaporation the saline matter is deposited. Thus, in the course of time, the Dead sea has come to contain a large quantity of salt. You see by the analysis on the diagram that this water contains 19736 grains of saline matter in a gallon, while the water of the Atlantic contains only 2139 grains. By referring to the small diagram on the right, you will see a comparison of the waters of some other inland seas with that of the ocean:

	Density.	Grains of saline matter in one gallon.	Ounces of saline matter in one gallon.
The Atlantic ocean	1.027	2139	4.89
The Dead sea	1.172	13488	30.86
The Great Salt lake	1.170	15203	34.72
Lake Oroomiah, in Persia	1.188	18209	41.60

You must not be surprised at the difference in the character of the salts contained in the Dead sea water and in the water of the ocean. The ocean receives the saline matters washed out of all the continents, while these inland seas are local in their sources of supply. They receive the washings of limited areas, and the salts they contain must necessarily partake of the character of those particular countries in which they are situated.

Mineral Waters.

Waters which contain unusually large quanties of any of the ordinary impurities, or which are characterized by unusual constituents, are known as mineral water. Such waters may be valuable for their medicinal properties, or as sources of the special substances which they contain. As examples of medicinal waters, we have sulphur springs, which contain sulphureted hydrogen, chalybeate springs, which contain iron, etc.; while brines and borax waters are valuable for the extraction of salt and borax.

Sulphur Waters.

Waters containing sulphureted hydrogen gas are found in many parts of the world. Those of Harrogate, Croft, and Aix la Chapelle, are renowned in Europe, while we have in the United States numerous examples, among which are the White, Red, and Salt Sulphur springs of Virginia, the White Sulphur springs of Ohio, and the Richfield, Sharon, Chittenango, and Florida springs of New York State.

The sulphureted hydrogen gives these waters a sweet taste and a very peculiar odor, which some consider offensive. These waters have the property of blackening silver; persons who visited these springs in the earlier days of the republic when specie was current, noticed a gradual darkening of their "change," which finally became quite black, owing to the formation of a black sulphide of silver.

If we add some acetate of lead to this jar of Chittenango water, we have at once a dense black precipitate of sulphide of lead as you see. If you will glance at this diagram you will see some analyses of sulphur waters which were made under my direction.

ANALYSES OF SULPHUR WATERS.

	CHITTENANGO, MADISON CO., N. Y.		FLORIDA, MONTGOMERY CO., N. Y.	
	White Sulphur spring.	Cave spring.	Magnesia spring.	Florida spring.
	Grains.	Grains.	Grains.	Grains.
Hydrosulphate of sodium *	0.117	0.386	0.757	2.006
Hydrosulphate of calcium*	....	1.123	0.929	....
Sulphate of potassa	....	....	....	1.390
Sulphate of soda	0.213	....	....	....
Sulphate of lime	81.420	106.126	115.085	....
Sulphate of strontia	Trace.	Trace.	Trace.	....
Sulphate of magnesia	1.953	7.589	12.718	....
Hydrosulphate of soda*	....	0.257	0.020	0.711
Bicarbonate of soda $(NaO,\ HO,\ 2CO^2)$	....	....	....	22.146
Bicarbonate of lime	....	....	....	8.317
Bicarbonate of magnesia	22.017	23.973	20.779	6.972
Bicarbonate of iron	0.078	0.156	0.325	....
Chloride of potassium	0.156	0.233	0.333	....
Chloride of sodium	1.037	1.569	1.833	5.880
Chloride of lithium	Trace.	Trace.	Trace.	....
Alumina	0.082	0.222	Trace.	Trace.
Silica	0.286	0.519	0.577	0.793
Sulphur (in suspension)*	Trace.	....	....	....
Sulphide of iron (in suspension*	....	....	....	0.176
Total solid contents per gallon	107.359	142.113	153.356	43.390
Total sulphur in the metallic sulphides and sulphuretted hydrogen.	0.339	1.397	2.454	1.916

* CUBIC INCHES OF GAS PER GALLON.

Sulphuretted hydrogen gas	0.884	2.754	5.623	3.786
Carbonic acid gas	20.480	15.934	19.456	32.199

With the exception of the following compounds, which are indicated by a star, the substances found in these waters are not essentially different from those contained in most spring waters:

Hydrosulphate of sodium	(NaS, H S).
Hydrosulphate of calcium	(CaS, H S).
Hyposulphate of soda	$(NaO,\ S_2\ O_3)$.
Sulphur	(S).
Sulphide of iron	(FeS).
Sulphuretted hydrogen gas	(H S).

To the last mentioned substance the peculiar odor of the water is due, while by the free sulphur, which is formed by the action of the oxygen of the air on this gas, the white milky turbidity is produced.

SALINE WATERS.

The chlorides of sodium, calcium and magnesium often occur in spring waters in such quantities as to cause a decided saline taste, agreeable in the case of the first mentioned salt, if not too intense, but bitter and disagreeable when caused by either of the others.

Sulphate of soda (Glauber salt) or of magnesia (Epsom salt) may be the cause of a saline taste. Brines, which are important sources of national wealth in many countries, belong to the first mentioned class. Nearly all the salt manufactured in the United States is obtained from salt springs or wells. This diagram exhibits analyses of some of the brines of Michigan and New York, made by Dr. C. A. Goessmann, of the Massachusetts Agricultural College:

ANALYSES OF BRINES.

	MICHIGAN.		NEW YORK.	
	East Saginaw Co.'s well.	Bangor Co.'s well.	Syracuse.	Salina.
Chloride of sodium	16.86	19.86	15.36	14.94
Chloride of magnesium	0.96	1.26	0.14	0.13
Chloride of calcium	2.27	2.96	0.08	0.08
Sulphate of lime	0.15	0.07	0.57	0.59
Total saline matter	20.24	24.15	16.15	15.74
Water	79.76	75.85	83.85	84.26
	100.00	100.00	100.00	100.00

Similar brines occur in Kansas, Ohio, West Virginia and other States. You will realize their importance when I tell you that 9,000,000 bushels of salt have been manufactured in the neighborhood of Syracuse in a single season. The brine is here pumped up through artesian wells from a depth of 400 or 500 feet. It is undoubtedly derived from beds of rock salt, such beds having been already discovered in Canada, not very far distant. The famous St. Catherines spring in Canada contains larger quantities of the chlorides of calcium and magnesium, which gives them a bitter taste. The Kissingen bitter water illustrates the class of waters that owe their peculiar qualities to the sulphates of soda and magnesia.

ACIDULOUS SPRINGS.

Waters charged with such quantities of carbonic acid as to cause them to sparkle and effervesce as they flow from the spring, are called *acidulous.* Owing to the solvent power of this acid upon limestones and some other rocks, such waters generally hold considerable quantities of lime, magnesia and iron in solution in the form of bicarbonates; when the latter is present in quantities of a grain or more to the gallon, the spring is called a *chalybeate*, from the name of an ancient people who worked in iron at an early day, the *Chalybes.* These waters often contain considerable quantities of chloride of sodium, and frequently bromide and iodide of sodium, as well as bicarbonates of soda and lithia.

Such is the character of the most celebrated mineral waters in this country, the well known springs of Saratoga and Ballston in this State. These waters are so well-known to you that I will take the liberty of dwelling upon their peculiarities for a few moments. In the first place I will call your attention to this section of the Saratoga valley, which shows you the position of the rocky strata there.

Beginning with the uppermost, the rocks of Saratoga county are: 1. The Hudson river and Utica shales and slates; 2. The Trenton limestone; 3. The calciferous sand rock, which is a silicious limestone; 4. The Potsdam sand stone; and, 5. The Laurentian formation, of unknown thickness. The northern half of the county is occupied by the elevated ranges of Laurentian rocks; flanking these occur the Potsdam, calciferous and Trenton beds, which appear in succession in parallel bands through the central part of the county. These are covered in the southern half of the county by the Utica and Hudson river slates and shales.

The most remarkable feature is, however, the break, or vertical fissure which occurs in the Saratoga valley, which you see indicated on my diagram. I want you to notice, specially, the fact that the strata on one side of the fissure have been elevated above their original position, so that the Potsdam sandstone on the left meets the edges of the calciferous sand rock, and even the Trenton limestone, on the right. It is in the line of this fissure, or *fault*, in the towns of Saratoga and Ballston, that the springs occur.

The Laurentian rocks, consisting of highly crystalline gneiss, granite and syenite, are almost impervious, while the overlying Potsdam sandstone is very porous, and capable of holding large quantities of water. In this rock the mineral springs of Saratoga probably have their origin. The surface waters of the Laurentian hills, flowing down over the exposed edges of the Potsdam beds, penetrate the porous sandstones, become saturated with mineral matter, partly derived, perhaps, from the limestones above, and are forced to the surface at a lower level, by hydrostatic pressure. The valley in which the springs all occur indicates the line of a fault or fracture in the rocky crust, the strata on the west side of which are hundreds of feet above the corresponding strata on the east.

The mineral waters probably underlie the southern half of the entire county, many hundred feet below the surface; the accident of the fault determining their appearance as springs in the valley of Saratoga Springs, where, by virtue of the greater elevation of their distant source, they reach the surface through crevices in the rocks produced by the fracture.

The common origin is also shown by analysis; all the springs contain the same constituents in essentially the same order of abundance, they differ in the degree of concentration merely. Those from the deepest strata are the most concentrated. The constituents to which the taste of the water and its most immediate medicinal effects are due are: chloride of sodium, bicarbonate of lime, bicarbonate of magnesia, bicarbonate of soda and free carbonic acid. Other important, though less speedily active, constituents are: bicarbonate of iron, bicarbonate of lithia, iodide of sodium and bromide of sodium. On this large diagram are my analysis of many of the most important of these waters. You will notice that the waters in the last four columns are from artesian wells. During the great petroleum excitement, a New York capitalist conceived the idea of finding oil at Ballston, so he selected a spot on the margin of the Kayaderosseras creek, a stream which flows through the village of Ballston into Saratoga lake. Here this patient but ill-advised seeker after petroleum bored down through sand, clay and hard pan fifty-six feet till he struck the solid rock. He tubed the well down to the rock with an iron tube six inches in diameter, and then continued the boring with a five-inch drill. For a considerable distance the drill passed through the Hudson river shales; then it penetrated the Trenton limestone, then the calciferous sand rock, and probably passed some distance into the Potsdam sandstone. At a depth of 571 feet, a vein of mineral water burst into the well, but, as oil was the object of the search, it was not heeded. Finally, our zealous borer was spared further labor in this direction by the steel reamer, which became so firmly fastened in the rock at the depth of 651 feet, that it could not be extricated. No oil making its appearance and further progress in the well being out of the question, attention was directed to the mineral water, when it was found that the most remarkable water of the county had been discovered. While the strongest natural springs of the county contain from 600 to 800 grains of mineral matter per gallon, this water contained over 1,200 grains. It is so concentrated that it will actually bear dilution with an equal volume of croton water, which is more than one can say of our city milk, though the experiment is often made by the milkmen.

Like the enterprise of sending warming pans to Cuba, this venture turned out an unexpected success. The well is now known as the "Ballston artesian lithia spring." Soon after the "Franklin" and "Condi-dentorian" wells were bored at Ballston, and more recently the "Geyser spouting well" at Saratoga. All these have been successful in bringing up very concentrated waters of the same chemical character as the natural springs. It is probable, therefore, that water can be obtained anywhere in the southern portions of the county by tapping the underlying Potsdam sandstone. In all of these wells the water rises to and above the surface. Down in the rocky reservoir the water is charged with gases under great pressure. As the water is forced to the surface, the pressure diminishes, and a portion of gas escapes with effervesence. The wells deliver, therefore, enormous volumes of gas with the water, a perfect suds of water, carbonic acid and carburetted hydrogen.

But we have neglected the analysis. While you are looking at them I will tell you about the High Rock spring, the greatest natural curiosity of the county.

Analyses of some of the springs and wells of Saratoga county, N. Y.

COMPOUNDS, AS THEY EXIST IN SOLUTION IN THE WATERS.	IN SARATOGA.								IN BALLSTON.		
	Star spring.	High Rock spring.	Seltzer spring.	Pavilion. spring.	United States spring.	Hathorn spring.	Crystal spring.	Geyser spouting well.	Ballston Artesian Lithia well	Franklin Artesian well.	Conde Dentonian Artesian well.
Chloride of sodium..............	398.361	390.127	134.291	459.903	141.872	509.968	328.468	562.080	750.030	659.344	645.481
Chloride of potassium...........	9.695	8.974	1.335	7.660	8.624	9.597	8.327	24.634	33.276	33.930	9.232
Bromide of sodium..............	0.571	0.731	0.630	0.987	0.844	1.534	0.414	2.212	3.643	4.665	2.368
Iodide of sodium................	0.126	0.086	0 031	0.071	0.047	0.198	0.066	0.248	0.124	0.235	0.225
Fluoride of calcium	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
Bicarbonate of lithia	1.586	1.967	0.899	9.486	4.847	11.447	4.326	7.004	7.750	6.777	10.514
Bicarbonate of soda	12.662	34.888	29.428	3.764	4.666	4.288	10.064	71.232	11.928	94.604	34.400
Bicarbonate of magnesia	61.912	54.924	40.339	76.267	72.883	176.463	75.161	149.343	180.602	177.868	158.348
Bicarbonate of lime	124.459	131.739	89.869	120.169	93.119	170.646	101.881	170.392	238.156	202.332	178.484
Bicarbonate of strontia..........	Trace.	Trace.	Trace.	Trace.	0.018	Trace.	Trace.	0.425	0.867	0.002	0.189
Bicarbonate of baryta....... ...	0.096	0.494	Trace.	0.875	0.909	1.737	0.726	2 014	3.881	1.231	4.739
Bicarbonate of iron	1.213	1.478	1.703	2.570	0.714	1.128	2 038	0.979	1.581	1.609	2.296
Sulphate of potassa......... ...	5.400	1.608	0.557	2.032	None.	None.	2.158	0.318	0.520	0.762	None.
Phosphate of soda	Trace.	Trace.	Trace.	0.007	0.016	0.006	0.009	Trace.	0.050	0.011	0.003
Biborate of soda	Trace.	Trace.	Trace.	Trace,	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
Alumina	Trace.	1.223	0.374	0.329	0 094	0.131	0.305	Trace.	0.077	0.263	0.395
Silica	1.283	2.260	2.561	3.155	3.184	1.260	3.213	0.665	0.761	0.735	1.026
Organic matter..................	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
Total per U. S. gallon.......	617.367	630.500	302.017	687.275	331.837	888.403	537.155	991.546	1,233.246	1,184.368	1,047.700
Carbonic acid gas	407.650	409.458	324.080	332.458	245.734	375.747	317.452	454.082	426.114	450.066	358.345
Density	1.0091	1.0092	1.0034	1.0075	1.0035	1.009	1 006	1.011	1.0159	1.0115	1.010
Temparature	52° F.	52° F.	50° F.	....	....	....	50° F.	46° F.	52° F.	52° F.	49° F.

Analyses of some of the springs and wells of Saratoga county, N. Y.

BASES AND ACIDS, AS ACTUALLY FOUND IN THE ANALYSES, UNCOMBINED.	IN SARATOGA.								IN BALLSTON.		
	Star spring.	High Rock spring.	Seltzer spring.	Pavilion spring.	United States spring.	Hathorn spring.	Crystal spring.	Geyser spouting well.	Ballston Artesian Lithia well.	Franklin Artesian well.	Conde Dentonian Artesian well.
Potassium	7.496	5.419	0.949	4.931	4.515	5.024	5.326	13.039	17.653	18.104	4.833
Sodium	160.239	163.216	61.003	182.084	57.259	202.058	132.006	251.031	299.005	286.221	263.769
Lithium	0.163	0.202	0.093	0.976	0.499	1.179	0.445	0.720	0.798	0.698	1.082
Lime	43.024	45.540	31.066	41.540	32.189	58.989	35.218	58.901	82.326	69.942	61.698
Strontia	Trace.	Trace.	Trace.	Trace.	0.009	Trace.	Trace.	0.211	0.430	0.001	0.094
Baryta	0.056	0.292	Trace.	0.517	0.537	1.026	0.429	1.190	2.292	0.727	2.799
Magnesia	16.992	15.048	11.051	20.895	19.968	48.346	20.592	40.915	49.480	48.731	43.363
Protoxyd of iron	0.491	0.598	0.689	1.040	0.289	0.456	0.824	0.396	0.639	0.651	0.929
Alumina	Trace.	1.223	0.374	0.329	0.094	0.131	0 305	Trace.	0.077	0.263	0.395
Chlorine	246.357	241.017	82.128	282.723	90.201	314.037	203.292	352.825	470.997	416.278	396.096
Bromine	0.443	0.568	0.489	0.767	0.656	1.188	0.322	1.718	2.829	3.623	1.839
Iodine	0.106	0.072	0.026	0.060	0.039	0.166	0.055	0.208	0.104	0.197	0 189
Fluorine	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
Sulphuric acid	2.483	0.739	0.256	0.934	None.	None.	0.992	0.146	0.239	0.350	None.
Phosphoric acid	Trace.	Trace.	Trace.	0.004	0.008	0.003	0.004	Trace.	0.025	0.006	0.002
Boracic acid	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
Carbonic acid, in carbonates	56.606	62.555	44.984	60.461	50.380	104.928	54.984	112.880	125.973	136.133	110.019
Carbonic acid, for bicarbonates	56.606	62.555	44.984	60.461	50.380	104.928	54.984	112.880	125.973	136.133	110.019
Silica	1.283	2.260	2.561	3.155	3.184	1.260	3.213	0.665	0.761	0.735	1.026
Organic matter	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.	Trace.
Water in bicarbonates	23.160	25.591	18.405	24.736	20.613	42.929	22.496	46.183	51.543	55.696	45.013
Oxygen in KO (SO_3)	0.496	0.148	0.051	0.187	....	....	0.199	0.029	0.048	0.070	....
Oxygen in LiO (HO, $2CO_2$)	0.187	0.232	0.105	1.116	0.570	1.347	0.509	0.824	0.911	0.797	1.237
Oxygen in NaO (HO, $2CO_2$)	1.206	3.323	2.803	0.358	0.444	0.408	0.959	6 785	1.136	9.011	3.277
Oxygen in $2 NaO$ (HO, PO_5)	....	....	....	0.001	0.002	0.001	....	....	0.006	0.001	Trace.
Total per U. S. gallon	617.367	630.500	302.007	687.275	331.837	888.403	537.155	991.546	1,233.246	1,184.368	1,047.700
Total residue by evaporation.	537.600	542.350	238.970	602.080	260.840	740.550	459.670	832.483	1,055.730	992.540	892.670

The High Rock spring was the first to attract attention. It was well known to the Indians, who highly prized the medicinal virtues of its waters. The Indian name Saraghtoga means *place of salt.* In 1767 they brought Sir William Johnson to the spring on a litter. The spring rises on a little mound of stone, three or four feet high, which appears like a miniature volcano, except that sparkling water instead of melted lava flows from its little crater. When Sir William Johnson visited the spring, and in fact until quite recently, the water did not overflow the mound, but came to within a few inches of the summit; some other hidden outlet permitting it to escape. The Indians had a tradition, however, which was undoubtedly true, that the water formerly flowed over the rim of the opening.

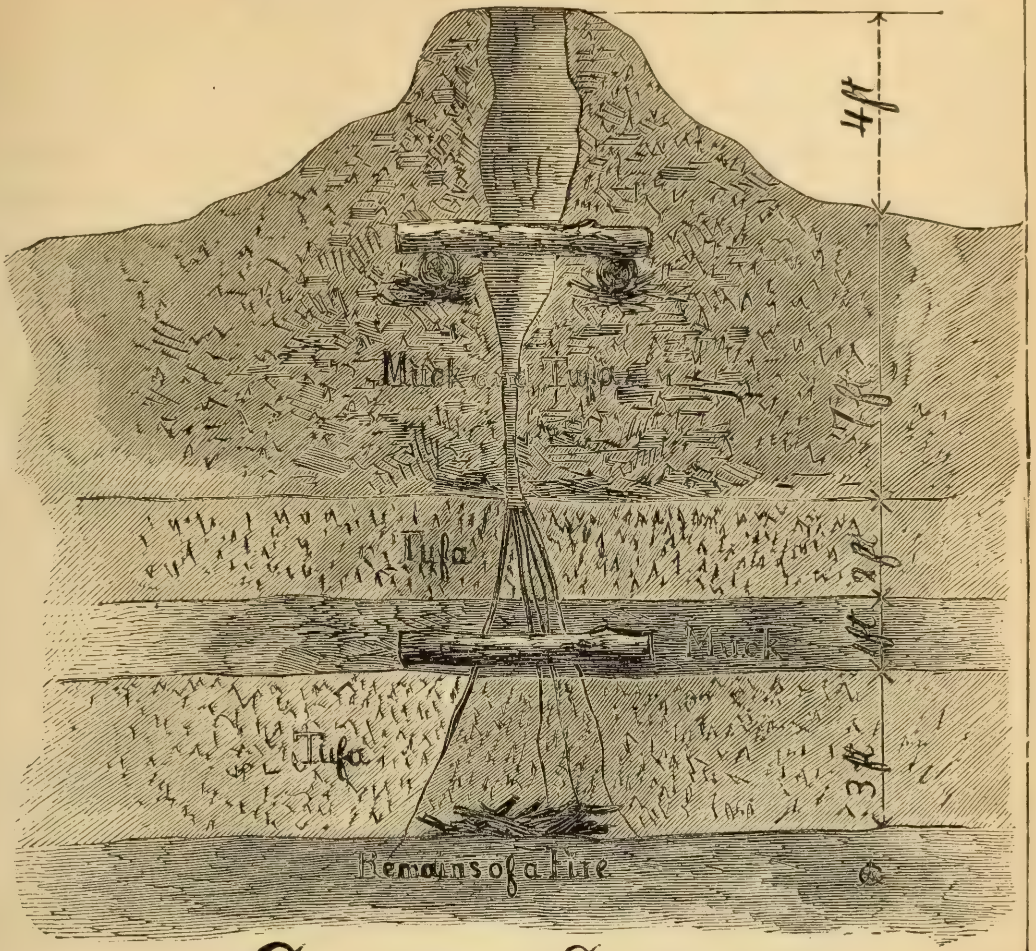
A few years ago the property changed hands, and the new owners, convinced that by stopping the lateral outlet they could cause the water again to issue from the mouth of the rock, employed a number of men to undermine the mound, and with a powerful hoisting derrick to lift it off and set it one side, that the spring might be explored.

If you will examine this diagram which presents a vertical section of the spring, you will be able to follow me as I tell you what they found.

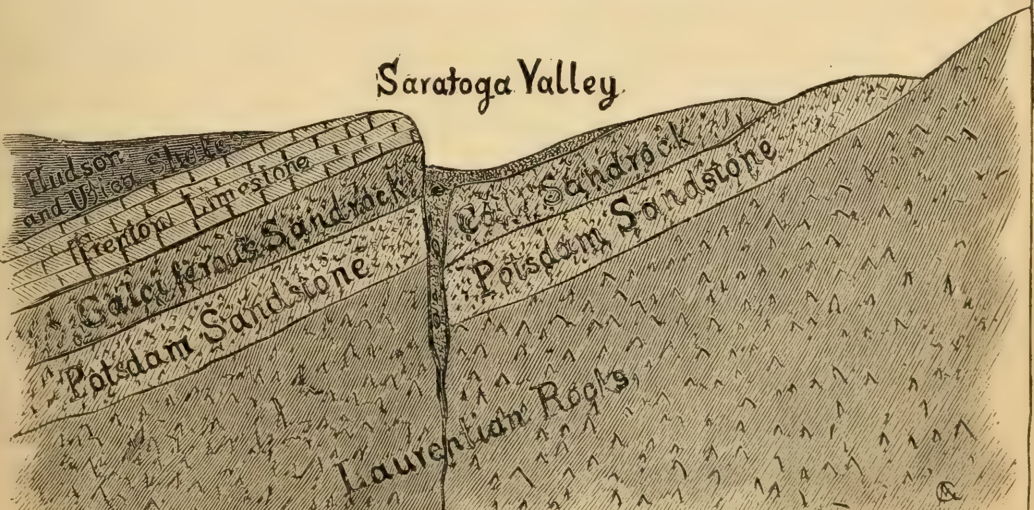
SECTION OF THE HIGH ROCK.

Just below the mound were found four logs, two of which rested upon the other two at right angles, forming a curb. I hold in my hand a piece of one of them. Under the logs were bundles of twigs resting upon the dark brown or black soil of a previous swamp. Evidently some ancient seekers after health had found the spring in the swamp, and to make it more convenient to secure the water had piled brush around it, and then layed down the logs as a curb. But you inquire how came the rock which weighed several tons above the logs? The rock was formed by the water. It is composed of tufa, carbonate of lime, and was formed in the same manner as the stalactites and stalagmites I described, were formed. As the water flowed over the logs, the evaporation of a portion of the carbonic acid caused the separation of an equivalent quantity of insoluble carbonate of lime which layer by layer built up the mound. I hold in my hand a large fragment of the rock; it contains leaves, twigs, hazel nuts and snail shells, which, falling from time to time upon it, were incrusted and finally imprisoned in the stony mass.

Section of the High Rock



Geological Section at Saratoga Springs.



C.B.COGSWELL.Sc.

Analysis of a Fragment of the High Rock.

Carbonate of lime	95.17
Carbonate of magnesia	2.49
Sesquioxyd of iron	0.07
Alumina	0.22
Sand and clay	0.09
Organic matter	1.11
Moisture	0.39
Undetermined	0.46
	100.00

Below the rocks the workmen followed the spring through four feet of tufa and muck. Then they came to a layer of solid tufa two feet thick, then one foot of muck in which they found another log. Below this were three feet of tufa; and there, seventeen feet below the apex of the mound they found the embers and charcoal of an ancient fire. By whom and when could the fire have been built? The Indian tradition went back only to the time when the water overflowed the rock, how many centuries may have elapsed since, even the logs were placed in position? A grave philosopher of the famous watering place, remembering that botanists determine the age of trees by counting the rings on the section of the stem, and noticing the layers in the tufa rock, polished a portion of the surface and counted eighty-one layers to the inch. He forthwith made the following calculation:

High Rock, 4 feet, 81 lines to the inch	3,840	years.
Muck and tufa, 7 feet, low estimate at	400	"
Tufa, 2 feet, 25 lines to the inch	600	"
Muck, 1 foot	130	"
Tufa, 3 feet	900	"
Time since the fire was built	5,870	"

As I have seen half an inch of tufa formed in two years on a brick which received the overflow from a spout of water containing only twenty grains of carbonate of lime in a gallon, I am inclined to think our antiquarian's estimates are not entirely reliable.

There are springs in the Auvergne, in France, in which the natives are in the habit of suspending little wire baskets containing egg shells, or craw fishes, or medallions, which become thickly incrusted with tufa in a few days. I hold in my hand now such a basket, containing four empty goose eggs, which are petrified, as it were, with solid carbonate of lime. You may inquire why I have not included in my table of analyses the well-known Congress and Empire springs. I reply, simply because the analyses of them, which are published, were made in the early days of analytical chemistry, and are not, therefore, very reliable. On this diagram you will find some partial analyses which I have made of nearly all the mineral springs of the county, which are sufficiently complete for comparison. The numbers represent grains in our United States gallon of 231 cubic inches.

WATERS OF SARATOGA COUNTY, N. Y.

TABLE *showing the total quantities of mineral matter left by evaporation, and of some of the more important constituents :*

SPRINGS.	Total solids as left by evaporation.	Chlorides of sodium and potassium.	All other solids left by evaporation; carbonates of lime, magnesia, etc.	Bicarbonate of lime ($CaO, HO, 2 CO_2$).	Bicarbonate of magnesia ($MgO, HO, 2CO_2$).	Bicarbonate of iron ($FeO, HO, 2 CO_2$).
Ballston Artesian Lithia well.	1,055.74	783.30	272.43	238.16	180.60	1.5
Franklin Artesian well	992.54	693.27	299.27	202.33	177.87	1.61
Conde-Dentonian well	892.67	654.70	237.97	178.48	158.35	2.2
Geyser Spouting well	832.483	586.71	245.77	170.39	149.34	0.98
Hathorn's spring	740.55	519.55	221.00	170.65	176.46	1.13
Hamilton spring.............	611.71	411.00	200.71	144.84	104.80	1.80
Congress spring.............	668.79	472.14	196.65	155.00	103.63	1.33
High Rock spring............	542.35	399.10	143.25	131.74	54.92	1 48
Washington spring	353.23	215.00	138.23	110.23	40.56	2.40
Excelsior spring	611.05	473.00	138.05	90.38	72.27	2.84
Pavillion spring	602.08	467.56	134.51	120.17	76.73	2.57
Putnam spring...............	354.79	220.50	134.27	110.72	60.01	3.97
Columbian spring..	353.08	219.00	134.08	104.89	78.05	3.26
Star spring	537.60	408.05	129.55	124.46	61.91	1.21
Crystal spring	459.67	336.79	122.88	101.88	75.16	2.04
Eureka spring	280.16	171.00	119.16	94.02	63.75	3.36
United States spring.........	260.84	150.49	110.35	93.12	72.88	0.71
Empire spring................	460.32	355.16	105.16	113.54	48.10	1.34
Seltzer spring................	238.97	135.62	103.35	89.87	40.34	1.7
Red spring....................	155.53	73.50	82.03	79.80	27.84	2.51
Village spring, Ballston......	153.09	75.00	78.09	65.08	21.59	2.00

Thus you see we have springs to suit all tastes from the concentrated artesian waters to the mild Saratoga Seltzer, which is used with wines, as our German friends are in the habit of using the original Seltzer, from the spring of the late Grand Duke of Nassau. Hathorn's spring is the strongest natural spring yet discovered in the county.

CHALYBEATES.

Almost all natural waters contain minute quantities of iron, generally in the form of bicarbonate. In the analyses of the Saratoga waters you see recorded from one to three grains of this compound of iron per gallon. All these waters are therefore chalybeates; but the properties of the iron are masked to a greater or less extent by the much larger quantities of other materials. I have before me sample of water which contains about two grains of iron to the gallon; and I will prove the presence of this metal by the same test that old Pliny employed before the destruction of Pompeii and Herculaneum.

I will pour into the water a little tincture of nutgalls. You see it has become black. The tannic acid of the nutgalls has formed ink with the iron. In fact, these ferruginous waters are characterized by a styptic or inky taste, due to the iron which they contain.

ACID WATERS.

It occasionally happens that springs are characterized by the presence of free mineral acids, such as sulphuric and hydrochloric. The river Vinagre, in South America, is supplied by such springs; and it is stated that this stream carries to the ocean daily an amount of acid equal to 82,720 pounds of oil of vitrol, and 69,638 pounds of concentrated muriatic acid. There is a celebrated spring of this character in New York State, known as the Oak Orchard acid spring, an analysis of which is shown on this diagram.

Analysis of the Oak Orchard Acid Water, by Professor Porter.

One gallon contains:

Sulpuric acid	133.312
Proto-sulphate of iron	32.216
Sulphate of magnesia	8.491
Sulphate of lime	13.724
Sulphate of alumina	6.413
Sulphate of potash	2.479
Sulphate of soda	3.162
Chloride of sodium	1.432
Silicic acid	3.324
Organic matter	6.654
Total grains	211.207

ALUM WATERS.

In several localities waters occur charged to a greater or less extent with alum, which is a double sulphate of alumina and potassa. These waters frequently contain free sulphuric acid; and it is probable that they were all first charged with this acid, which, acting on feldspathic rocks or slates, has dissolved the alumina, potash, etc., forming the sulphates found in them as they issue at the surface. The Rockbridge alum spring, and the Church Hill alum spring, in Virginia, are examples of this class of waters.

BORAX WATERS.

Minute quantities of borax (biborate of soda) are found in many mineral waters; as, for instance, the waters of Saratoga; but in a few localities waters occur so heavily charged with this salt as to make it worth while to extract it for manufacturing purposes. Instead, however, of evaporating the waters to extract the borax which they contain, the borax gatherers content themselves with collecting the crystals formed by natural evaporation along the margins and on the muddy beds of the borax lakes. For many years considerable quantities of borax, called tincal, were brought from a salt lake in Thibet. More recently, California has thrown down the gauntlet by developing borax lakes of great size, in which occur enormous quantities of this valuable salt. No complete analyses of the waters of these lakes has yet been published; but, according to G. E. Moore, the water contains 535 grains of borax per gallon. Near the borax lake is situated a wonderful hot spring, from which, and perhaps from others of similar character, the borax of the lake has been derived. I will call your attention to this diagram, on which is recorded an analysis of this spring, made by Mr. Moore:

Analysis of a Borax Spring, California.

	Grains in a gallon.
Chloride of potassium	Trace.
Chloride of sodium	84.62
Iodide of magnesium	.09
Bromide of magnesium	Trace.
Bicarbonate of soda	76.96
Bicarbonate of ammonia	107.76
Biborate of soda	103.29
Sulphate of lime	Trace.
Alumina	1.26
Carbonic acid (free)	36.37
Silicic acid	8.23
Matters volatile at a red heat	65.77
Total grains in one United States gallon	484.35

SILICEOUS WATERS.

Almost all natural waters contain small quantities of silica, in the neighborhood of one grain in a gallon; but the waters of hot springs, especially those which contain alkaline carbonates, are largely charged with silica, and in the neighborhood of their outlets, large masses of siliceous tufa are formed.

The water of the famous Geyser in Iceland, contains twenty-four grains of silica in the gallon. This fragment of siliceous tufa which I hold in my hand is from one of the hot springs of the Azores.

Water for Manufacturing Purposes.

For manufacturing purposes, pond or river water is generally selected, not only because it can generally be obtained in unlimited quantities, but also because it is generally softer than spring water. The impurities of waters are objectionable in several ways. When used in stationary or locomotive boilers, impure waters produce incrustations which often form a complete lining. I saw 1,300 pounds of calcareous incrustation taken from the boiler of a single locomotive on the N. Y. C. R. R.

These stony masses which I hold in my hand, and which you see are from one to two inches in thickness, are incrustations from boilers, fed with hard water. These incrustations are very poor conductors of heat. Their presence in boilers, causes, therefore a great waste of fuel. It is estimated by the French engineers that forty-five per cent of the fuel burned under locomotive boilers, is required to overcome the nonconducting power of the incrustations. Furthermore these scales prevent the contact of the water with the plates of the boiler, the metal becomes therefore overheated, and is rapidly burned out, making frequent repairs necessary. Boiler explosions are sometimes attributed to the presence of incrustations; the metal becoming very much overheated, causes the scale to crack, which permits the water to come in contact with the hot metal; a great quantity of steam being at once generated, the boiler is burst. These incrustations vary somewhat in character with the impurities of the waters by which they are produced. Their chief constituents are carbonate of lime, carbonate of magnesia and sulphate of lime. On this diagram you will see some of my analysis of incrustations from locomotives on the N. Y. C. R. R.

Analyses of Boiler Incrustations.

SOURCE.	Structure.	Thickness.	Sulphate of lime.	Carbonate of lime.	Basic carbonate of magnesia.	Oxyd of iron and alumina.	Water.	Organic matter.	Silica.	Total.	
1. Stationary engine, boiler shop, Syracuse; hydrant water....	Compact and crystalline.	3-16ths inch.	74.07	14.78	9.19	0.08	1.14	undet.	0.65	99.91	Fair average representatives of the usual incrustations.
2. * Stationary engine, machine shop, Rochester; canal water, 10 months, well water, 2 months..	do	2 inches.	71.37	......	....	§26.87	......	.....	1.76	100.00	
3. Locomotive, No. 211. Freight, both roads. Syracuse..................	do	1-32d inch.	62.86	12.62	18.95	0.92	1.28	undet.	2.60	99.23	
4. Locomotive; surrounding a brace....	do	1-4th to 1-3d in.	53.05	......	....	§42.16	......	......	4.79	100.00	
5. Locomotive, No. 127. Freight, both roads. Syracuse.............	do	1-32d inch.	46.83	......	....	§47.85	......	......	5.32	100.00	
6. Locomotive, No. 202. Freight, both roads. Syracuse..................	do	1-4th inch.	30.80	26.93	31.17	1.08	2.44	undet.	7.75	100.17	
Average............................	....	....	56.49	18.11	19.77	0.69	1.62	undet.	3.81	......	....
7. † Stationary engine, Niagara Falls; river water.	Friable and granular.	2 inches.	4.95	86.25	2.61	1.03	0.63	undet.	2.07	97.54	Exceptional incrustations, the only ones of their kind analysed.
8. ‡ Stationary engine, Townsend's Furnace, Albany.................. ...	do	1¼ inches.	0.88	93.19	¶2.84	0.36	0.15	1.96	0.62	100.00	
9. Locomotive, No. 122; Rochester to Buffalo........................	Powder.	....	4.81	......	....	§92.27	......	......	2.92	100.00	
10. Stationary engine, Barhydt and Greenhalgh, Schenectady	do	....	30.07	. ....	....	§61.69	......	......	8.24	100.00	

* A mass weighing twenty-one ounces, which had apparently filled the space between three tubes.

† A mass weighing fourteen ounces, evidently detached from a tube.

‡ A mass weighing sixteen ounces, evidently detached from a tube.

§ This number includes those belonging to the two preceding and the two following columns, as obtained by difference.

Various substances are employed to prevent the formation of these incrustations in boilers, some of which are very effective. Amylaceous, saccharine and extractive matters tend to prevent the carbonates of lime and magnesia from forming a hard scale, causing them to separate as a loose mud, which can be easily washed from the boiler at convenient intervals. Potatoes, molasses, extractive matters, or substances which yield them, as logwood sawdust, are consequently employed with varying success. Astringent substances, which contain tannic acid, have a similar action. To this class belong catechu extract, oak sawdust, tan bark, etc. Solid particles, as sawdust, clay chopped straw, etc., serve to diminish the formation of hard scale by presenting nuclei, upon which the earthy carbonates are deposited. For the decomposition of sulphate of lime, carbonate of soda and chloride of barium are employed. Sal ammoniac is sometimes employed to convert the carbonate of lime into soluble chloride of calcium, and thereby prevent its being deposited. The substances which I have enumerated are placed in the boiler from time to time and allowed to act there. An English chemist, Mr. Clark, proposed purifying the water beforehand by adding lime water, on the principle of *similia similibus curantur;* but, unfortunately, more than a homœopathic dose is required. The carbonate of lime in the water is held in solution by carbonic acid as a bicarbonate. The lime, which Mr. Clark adds, takes this extra carbonic acid, forming an insoluble carbonate, and at the same time precipitating the lime of the bicarbonate as insoluble carbonate. The magnesia present is also precipitated by the lime water; but the sulphate of lime, which forms the hardest and most crystalline incrustations, is not removed by this process. The real objection to this process arises from the vast quantities of water required in practice. A locomotive consumes on the average about forty-five gallons of water for every mile that it runs, and on the New York Central railroad alone about 300 locomotives are employed. As at least twenty-four hours are required to enable the precipitated lime to settle from the water, enormous reservoirs or tanks would be required to contain a sufficient supply for a railroad. An excellent device has been patented by Stillwell, to be used in connection with stationary boilers. It is simply a box containing a great number of horizontal shelves. The water for supplying the boiler passes through this, and the exhaust steam from the engine is also admitted to it. The exhaust steam causes the water to boil, and most of the lime, which it contains in the form of bicarbonate, separates as insoluble carbonate, lodging on the shelves or being caught by a filter of straw at the bottom of the box.

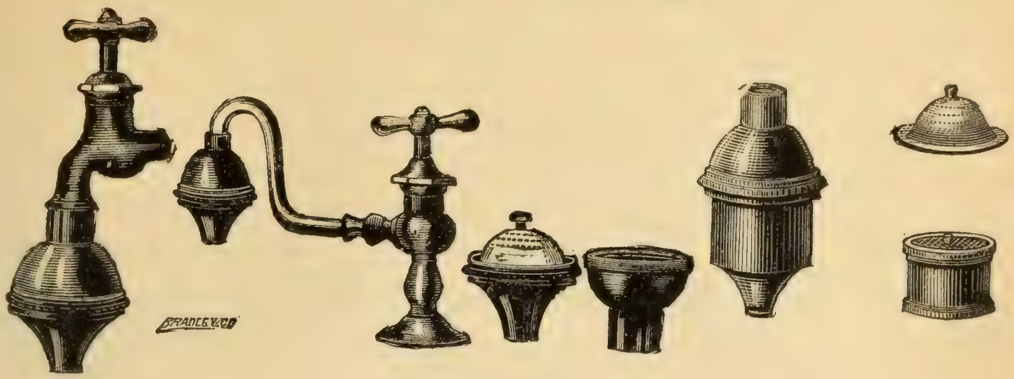
Great annoyance was formerly experienced by marine engineers, whose boilers were fed with sea water. Not only was there formed a very hard strong scale of sulphate of lime, often an inch or more in thickness, but even the salt separated, sometimes entirely filling the spaces between the tubes. By noting the density of the water in the boiler with a hydrometer, and blowing out a portion of the concentrated sea water from time to time, the engineer was able to prevent the separation of salt; but the separation of sulphate of lime could not be prevented. This became so great an evil, causing the very rapid destruction of the boilers, that the use of sea water had to be abandoned. Marine boilers are now provided with condensers, by which the steam, after doing its work in the cylinder, is condensed to water again and returned to the boiler. A supply of fresh water is taken on board before leaving port, and is used over and over again, until the vessel reaches her destination.

Often for washing or for cleaning cotton, wool or other fabrics, the impurities of water are a great objection; they destroy soap, they affect colors in dyeing; for sugar refineries and in brewing, the character of the water is of great importance. In fact the highly prized flavor of some of the English ales, is attributed to the impurities in the water used.

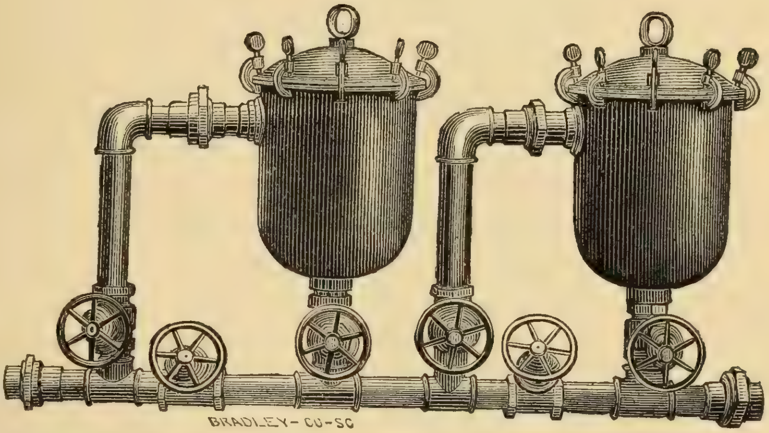
FILTERING WATER.

Filtration is one of the simplest methods for purifying waters; its action is limited to the suspended impurities such as mud, animal and vegetable substances, etc. Any porous material may be employed in the construction of a filter, the selection being generally governed by the magnitude of the operation. For city supplies, reservoirs are constructed which are provided with porous partitions, or so arranged that the water is obliged to percolate through beds of sand and gravel. I hold in my hand a very simple filter, which has recently been devised for domestic use. It contains, in the first place, a little cup filled with coarse charcoal and provided with a net work of wire gauze. Above that is placed a common sponge pressed firmly into its place so that it entirely fills the space. This is encased in a little perforated cup and is placed over the charcoal vessel. The water which passes through this is, therefore, obliged to pass through the sponge, and then through the charcoal. Although it acts as a perfect filter, it does not seriously interrupt the flow. The advantage of this filter is, that

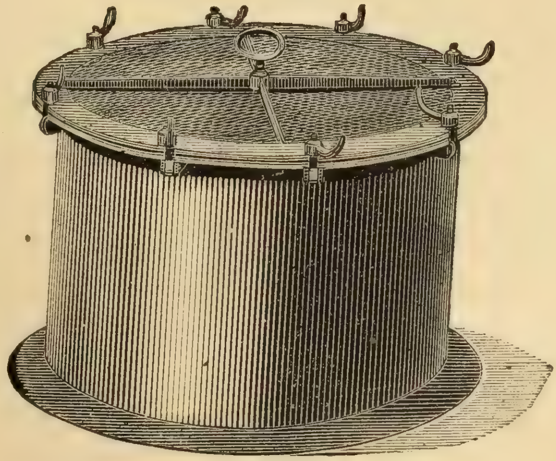
SPONGE FILTERS.



House Filters.



Constant House, Hotel, Steam Boiler and Paper Engine Filter.



Steam Paper Machine Filter.

when it becomes clogged and the flow of the water is impeded by the impurities separated, it is merely necessary to open it and take out the sponge, wash it and return it to its place. I have here a little bottle of impurities which were filtered out of the Croton, in a comparatively short time by one of these filters.

Filters are constructed on the same principle for use in manufacturing establishments. Here is one suitable for a large factory or hotel. As there are really two filters, either one may be cleansed without interfering with the flow of water through the other, as you see by the arrangement of the cocks.

Here is a much larger filter, containing six chambers for holding sponges, each six inches in diameter, which is designed for paper factories where large quantities of water are used.

Another filter which is often attached to faucets in houses, is the common sand filter. It is attached in the same way, and by and by when it becomes clogged, it is merely necessary to reverse it when the first glass of water passing through, cleans it. This does not permit so free a flow of water as the sponge filter, and, moreover, it is liable to become permanently obstructed by impurities.

BOILING WATER.

Impurities of animal and vegetable origin, are often rendered inert and harmless by simple boiling, and travelers in malarious countries consider this simple precaution a very efficient protection against some of the diseases peculiar to the locality.

DISTILLATION.

Distillation is really the most effective method for purifying water, but it is only applicable in special cases. The analytical chemist, the photographer, and sometimes the pharmaceutist are compelled to resort to distillation to obtain water sufficiently pure for certain of the operations incident to their respective professions. We have already alluded to the use of condensers on steamships. Almost all vessels are now provided with an apparatus by which the sea water may be distilled for drinking purposes in case of a long voyage or deficient supply of fresh water.

OTHER METHODS OF PURIFYING WATER.

Charcoal has the property of purifying water contaminated by organic matters. On this account, water-casks are generally charred on the inside to the depth of an eighth of an inch or so, and it is a common practice when rain water cisterns become foul, to throw in a bushel or two of fresh charcoal.

Permanganate of potassa, commonly called chameleon salt, is very effective in destroying organic matter in water. Travelers are advised to carry with them a small vial of the crystallized salt. A small particle added to a glass of water, renders it pure, and in a few moments, oxydizes or burns up the impurities, which taken into the system might produce typhoid fever or dysentery. Running streams undergo purification by the oxygen which they absorb from the air. Very impure waters when placed in casks on shipboard frequently undergo a kind of fermentation by which the impurities are worked off, and the waters rendered sweet and wholesome. This phenomenon has been noticed in the case of Thames water. Contact with iron, as when water is stored in iron tanks, effects a speedy purification.

WATER FOR DOMESTIC PURPOSES.

For domestic purposes the water of springs is generally selected, because it is cool and clear, having undergone a natural underground filtration; but, as already shown, spring water generally contains a larger quantity of dissolved impurities, hence it is generally harder, than river or pond water. Ordinary wells receive their supply of water partly from springs and partly by drainage. They are, therefore, very liable to be contaminated with the soluble impurities of sewage, and frequently serve to disseminate special diseases, such as cholera and typhoid fever. I have in these jars a sample of such a well water, and will show you some of the peculiar impurities which it contains. To the water in this first jar we will add some of what is called Nessler's solution, a compound of iodide of mercury, with iodide of potassium. You see the liquid has assumed a deep orange color, a proof that the water contains a considerable amount of ammonia. In this jar is some of the same water, which has been previously concentrated and mixed with strong sulphuric acid. Now on adding to this protosulphate of iron (copperas), you see a deep brown color is produced. This is due to the nitrates and nitrites which are contained in the water. Both the ammonia and the nitrates are derived from infiltration of animal matter, from the soil around the well. In the water of a clear and delightfully cool spring, highly prized by the people of the neighborhood, which flowed from a side hill adjacent to a graveyard, phosphate of lime was found by suitable tests, which was derived undoubtedly from the bones of the departed.

Deep artesian wells, which bring water from deep lying strata, supplied from a distance, are free from organic impurities, though they often contain so much mineral matter as to give them medicinal qualities. This is the case with Dupont's artesian well in Kentucky. Recently, the tube or drive well has become quite popular; a simple iron tube or pipe is driven down through the soil, and in some cases a continual flow of water is obtained, otherwise, a pump is applied, but of course you get the drainage water, though not to the same extent as in an open well. The drive well is, I believe, an American invention; it was extensively employed by the British army in Abyssinia.

For the supply of water-works of cities and large towns, ponds or rivers are resorted to, as furnishing the purest water in sufficient quantities, though, in a few cases, artesian wells have been relied upon.

Characteristics of a Good Drinking Water.

The characteristics of a good drinking water may be enumerated as follows:

The temperature should be at least ten degrees lower than the temperature of the atmosphere, but it should not be much lower than forty-five degrees Fahrenheit.

It should be free from taste, except, perhaps, a slight pungency from oxygen and carbonic acid, which is an advantage. Taste is, however, a poor guide. When one becomes accustomed to a certain water, pure water tastes flat by comparison; fifty grains of chloride of sodium in a gallon would hardly affect the taste perceptibly.

A third requirement is freedom from smell. This should not be apparent, even when a bottle is half filled with the water, placed in a warm place for a few hours, and then shaken.

It should be transparent; not that it is necessarily poisonous if not transparent, but it is preferable to take our solid food in other forms. Sometimes water may contain peaty matter from swamps, or vegetable matter from new reservoirs which is not necessarily unwholesome.

With regard to the total quantity of impurities admissible in good drinking water, the sanitary congress which met at Brussels decided that water containing more than thirty-five grains of impurity in one gallon is not wholesome, and that there should not be much more than one grain of organic matter. Thirty-five grains is a large quantity for city water, though drainage wells frequently contain more. The quality of the impurities is more important than the quantity. It is found that five or six grains of lime or magnesia render water unfit for the cooking of leguminous vegetables. On the other hand, it is a great advantage in making tea or coffee to use water of about five degrees of hardness; that is, containing about five grains of carbonate of lime or its equivalent in the gallon. A person of very nice taste can tell the difference in tea or coffee made with water in which the difference is not more than two or three grains of lime or magnesia to the gallon. It is on this account that certain wells have a great reputation as "tea wells." In olden times there were two or three such wells in New York, and a boy was kept by the corporation to pump water for the benefit of the natives. The fine flavor of the tea made with such water is due to the fact that the five or six grains of carbonate of lime prevent the water from dissolving the astringent matter contained in the tea, without interfering with the extraction of the theine and the other desirable constituents of the leaf.

Magnesia in large quantities is objectionable, as are also lime salts. They are liable to cause dyspepsia. It is said that horses acquire a rough coat if supplied with water containing a large quantity of sulphate of lime. Goiter and cretinism are attributed to these impurities in the water; at least the facts observed make this extremely probable. The goiter appeared in the Darham jail, afflicting a large proportion of the convicts. The spring water with which they were supplied was analyzed, and found to contain seventy-seven grains of lime and magnesia salts per gallon. On substituting for this, a water containing only eighteen grains of these salts, it was found that the old cases rapidly improved, while no new cases made their appearance. In the limestone districts of England, Switzerland and central New York, this goiter has been traced over considerable areas. At Goruckpoor in India, where the waters are quite calcareous, ten per cent of the adults are afflicted with goiter, and many of the children are cretins. Even the cats and dogs are said to be afflicted with cretinism, which is a kind of idiotic insanity. It is a curious fact that in Ireland on the Waterford side of the Suir, where sandstones and slates prevail, goiter and cretinism are almost unknown, while on the Kilkenny side, where limestones abound, goiter is not uncommon. Perhaps the idiotic behavior of those famous Kilkenny cats is attributable to the calcareous impurities of the water with which these unfortunate quadrupeds slaked their thirst.

The products of the decomposition of animal matter in water, is, however, the most objectionable impurity. Organic matters, produced by the decomposition of vegetable substances, are not especially dangerous, but the products of decomposing animal substances are highly dangerous, even when in minute quantities. These impurities do not make themselves apparent to the taste. On the contrary, such waters are frequently considered unusually fine in flavor, and persons go a great distance to procure them. Nevertheless, they contain an active poison. Many diseases of the most fatal character are now traced to the use of water poisoned with the soakage from soils charged with sewage and other animal refuse. Sudden outbreaks of disease of a dysenteric character, are often caused by an irruption of sewage into wells, either from a break in the sewer or cess-pool, or from some peculiarity of the season. Such contamination of the water is not indicated by any perceptible change in the appearance of the water. The filtered sewage, clear and transparent, carries with it the germs of the disease. At a convent in Munich, thirty-one out of 121 of the inmates were affected with typhoid fever. It was found upon investigation that the well was polluted by sewage, and the disease disappeared as soon as the proper repairs were made.

At Pittsfield, Mass., typhoid fever suddenly broke out in a large boarding-school for young ladies. The water was found to be contaminated with sewage owing to a leak in the cess-pool.

At Edgewater, on Staten Island, in 1866, the inmates of a small block of houses were afflicted with typhoid fever, several deaths occurring. On making investigation, the health officers found that a neighbor, through whose land the underground drain passed, had taken the liberty of closing up the drain, thus sending its contents back upon this block of houses, contaminating the well, and thus actually murdering the unfortunate victims with sewer poison.

Dr. Stephen Smith, one of the health commissioners of this city, describes an interesting case that came to his knowledge. He visited an old schoolmate, a clergyman, in the country, and in the course of conversation his friend told him of a family in which typhoid fever had made its appearance, three members having already died, while the rest were not yet convalescent. The physician called the attention of his friend to the fact that typhoid fever is now attributed to the poisoning of the water by animal refuse. This was new to his friend, the clergyman, who had not thought of attributing it to anything else than to the visitation of Providence. They went together to visit the locality, and found that in the autumn, when the laborers on the farm were busy taking in the crops, one of the valves of the pump got out of order. Being unable to get their usual supply of water, and being too busy to send for the pump maker, they sent a man down to a neighboring spring to draw water, but finding that it was not easy to dip the water of the spring, from the shallowness of the pool, drew his supply from a brook near by. They found that this brook received the drainage from the barnyard of a neighboring farm.

It is a common saying in villages and towns that "There was health in the old houses, while there is death in the new." This is owing to the fact that when villages were first settled, the houses were supplied with water from the springs on the hill side, while, as the dwellings multiplied in number, these sources of supply proving insufficient or too distant, wells were sunk in the valley, which, of course, received the drainage of the locality. Hence diseases such as typhoid and typhus fever, diphtheria, etc., which were unknown to the early settlers, ultimately become prevalent.

I might multiply illustrations without end, of cases in which diseases have been directly traced to impure water. I have here a little diagram which illustrates a case that occurred in the little town of Charmouth, in England, a little village situated on the side hill, at the mouth of the Char. The houses are supplied from surface wells, sunk in the gravel and marl.

Typhoid fever broke out. My friend, from whom I obtained the facts, was a scientific man, and knowing that it was not safe to drink the water from these wells, so informed his friends, whom he directed to draw their supplies from the spring above the village. My friend had half a dozen children. Two or three of them were strong enough to manage the pump, and against this express order they drew the water from the well, and drank it. They got the disease as a consequence; but none of the children who could not use the pump, and none of the neighbors, who drew water from the springs, were affected.

This city, during the last century, and before the introduction of sewers or the Croton water, was ravaged every few years by deadly epidemics, which are now believed to have been favored and invited by the defilement of the wells then in use, by sewage and fœcal soakage. No such visitation has occurred since the introduction of the Croton water, and the completion of the very perfect system of sewers.

Cholera, though it does not originate from polluted water, is disseminated chiefly by the aid of wells, and other impure water supplies.

At Exeter, England, in 1832, 1,000 deaths occurred from Cholera. A purer supply of water was then introduced from a locality two miles higher up the river, above the point at which it received the sewage of the town. When the Cholera again invaded the city in 1849, only forty-four cases occurred, and in the Cholera season of 1854, there was hardly a case.

In London, in 1854, the water supplied by the Southwark Company contained much sewage, while that supplied by the Lambeth Company was very pure. Both companies had pipes in the same streets, supplying water indiscriminately on both sides. Among those who used the Southwark water, the deaths amounted to 130 in 10,000, while among those who drank the Lambeth water, they amounted to only thirty-seven in 10,000; 2,500 persons were destroyed by the Southwark water in one season. On the previous visitation of 1848–9, the case was the reverse. The deaths from the Lambeth amounted to 125, while those from the Southwark amounted to 118 in 10,000. At that time, the Lambeth company took their water from a point lower down the river.

Another very striking instance occurred in London. The famous Broad street pump supplied water in one of the most fashionable localities of the West end. During the visitation of 1848–9, this pump killed 500 persons in a single week, by disseminating cholera. The wealthy people of the West end went to Brompton, a fashionable summer resort, about five miles up the Thames, and soon the cholera broke out among them there. The health officers soon discovered, on investigation, that these people had been in the habit of sending to the Broad street pump for tea-water, and had brought the cholera with it. A curious case was that of an old spinster, who had moved to Hempstead, three miles from the pump, but who sent her maid daily, for a kettle of the highly prized tea-water. She and her maid were the only persons who suffered from cholera at Hempstead.

A similar story might be told of an outbreak of cholera in a shanty village, west of Central park, and another in a shanty village on the heights across the river. In both cases, it was clearly shown that the cholera germs were distributed among the unfortunate squatters by the waters of the single well in each village. There is a famous pump in the twelfth ward of Brooklyn, at the corner of Van Brunt street, from which over fifty families obtained their water supply. In 1866 cholera broke out in five or six of these families, but the spread of the disease was prevented by the prompt action of the health officer, who removed the pump handle.

From these facts, it is seen that water aids in disseminating two of the most fatal diseases which affect the human race; the typhoid fever and the deadly cholera. During the ten years from 1856 to 1866, there were 21,000 deaths from cholera in England and Wales, and 150,000 deaths from typhoid fever. There is every reason to believe, that at least three-fourths of these deaths might have been prevented had proper attention been paid to the purity of the water supply. This poisoning by bad water is now fully established, and must awaken communities to the vital importance of securing a pure and unfailing supply of this indispensable beverage. Shakespeare describes blood poisoning as graphically as if he were describing the effects of bad water, when he says:

> "Whose effect
> Holds such an enmity with the blood of man
> That, swift as quicksilver, it courses through
> The natural gates and alleys of the body,
> And with a sudden vigor it doth posset,
> And curd, like eager droppings into milk
> The thin and wholesome blood."

Besides the diseases which I have mentioned, it may be considered as fully established that the ova of entozoa (the eggs or embryos of parasitic worms) gain entrance to the body by the water we drink. We have no reason to believe, however, that the animalculæ to which I have already called your attention, as existing in the Croton and Ridgwood waters, and which you saw in all their activity projected on the screen, by the compound microscope, are such embryos; or, in fact, that they are in any way objectionable.

In Iceland, however, it is stated that one-sixth of the deaths are caused by hydatids in the liver. These are the larval forms of the tania or tapeworm of the dog. Young leeches, contained in drinking water, sometimes fix themselves on the pharynx. In a march of the French in Algiers, 400 men were in the hospital at one time from this cause.

METALLIC IMPREGNATIONS.

Water is frequently rendered impure by the metallic tubes used to conduct it. Organic matter, nitrates, nitrites, chlorides, etc., and in some cases even pure water attack certain metals, causing them to dissolve. Cases of sickness have occurred caused by water drawn through copper pumps, copper having been actually detected in the water. Lead is by far the most common material used in the construction of service pipes for water, and this metal is the one which is the most easily dissolved by water, and at the same time most poisonous in minute quantities, being a cumulative poison. A celebrated case occurred in the royal family of France, at Claremont, where one-third of the persons who drank of the water were affected. This water contained only one-tenth of a grain of lead in a gallon.

As little as 1-100 of a grain of lead to the gallon, has been known to produce palsy in persons who habitually drank it. It is a great pity that the peculiar advantages of lead as a material for the manufacture of water pipes, is more than counterbalanced by the danger of lead poisoning.

When the Croton water was first introduced into New York, it contained considerable lime derived from the mortar of the recently constructed aqueduct. This prevented, to a considerable extent, the action of the water on the lead pipes, and it was stated at that time, that no lead was taken up by the Croton water, but as the lime of the mortar became carbonated, the water ceased to dissolve it and began to act upon the lead pipes. Recently, the attention of the Metropolitan Board of Health having been called to the frequent cases of chronic lead poisoning which occurred in the city, I was requested to investigate both the Croton water, and the various hair tonics, invigorators and washes in common use, with a view to discovering the probable cause of the poisoning. For the benefit of the ladies I will say, that the latter preparations almost invariably contained lead, some of them in very large quantities, and that their efficiency in coloring the hair, and restoring its original color, depends upon the proportions of the poisonous metal they contain.

If they will glance at the diagram on the wall, they will see the number of grains of lead which I obtained from one fluid ounce of each of several of the more popular cosmetics of this character.

Grains of Lead in one Fluid Ounce.

Clark's Distilled Restorative for the Hair	0.11
Chevalier's Life for the Hair	1.02
Circassian Hair Rejuvenator	2.71
Ayer's Hair Vigor	2.89
Prof. Wood's Hair Restorative	3.08
O'Brien's Hair Restorer America	3.28
Gray's Celebrated Hair Restorative	3.39
Phalon's Vitalia	4.69
Ring's Vegetable Ambrosia	5.00
Mrs. S. A. Allen's World's Hair Restorer	5.57
L. Knittel's Indian Hair Tonique	6.29
Hall's Vegetable Sicilian Hair Renewer	7.13
Dr. Tebbett's Physiological Hair Regenerator	7.44
Martha Washington Hair Restorative	9.80
Singer's Hair Restorative	16.39

Examinations were also made of Croton water, which had been in contact with lead for different lengths of time, under usually occurring circumstances, of which the following are the results:

1. A gallon of Croton water from a lead-lined cistern, in which it had stood several weeks, was found to contain 0.06 grain of metallic lead.

2. A gallon of water which had remained six hours in the lead pipes of my residence yielded 0.11 grain metallic lead, a considerable portion of which was visible to the eye, in the form of minute white spangles of the hydrated oxycarbonate ($PbO,HO+PbO,CO_2$).

3. Water drawn from one of the hydrants of the School of Mines laboratory, in the middle of the day, when the water was in constant motion, yielded traces of lead. This water reaches the school through about 100 to 150 feet of lead pipe.

These results indicate the source of many hitherto unaccountable cases of lead poisoning, and are of a character to alarm the residents of New York, and to lead them to adopt precautionary measures for protection against this insidious cause of disease.

Certainly no pains should be spared to impress upon servants the importance of allowing the water to run for a few minutes before taking it for drinking or cooking purposes, specially early in the morning, after the water has stood all night in the pipes. The habit of filling the tea-kettle from the boiler, or of using water from the boiler for any purpose except washing, is very dangerous.

My second experiment explains a case which recently occurred in New York. An elderly gentleman was completely prostrated with paralysis or palsy. His physician at once suspected lead poisoning from his symptoms, and instituted inquiries which developed the fact that the patient had been using wheaten grits for dyspepsia, and that the first duty of the cook in the morning had been to soak them, preparatory to boiling them. She had therefore used daily the water which had stood all night in the pipes. The occurrence of a considerable portion of the lead in experiment No. 2, in suspension, instead of solution, is an additional argument for the use of filters, though it will of course be useless to employ them unless they are frequently reversed, that they may be cleansed.

Manufacturers of lead pipe have frequently appeared in the New York papers with theoretical arguments to prove that the Croton water cannot possibly dissolve lead; but I believe that my simple facts outweigh folios of theory.

Dr. Lardner made an elaborate statement to his audience why a steamer could never cross the Atlantic ocean; but before the audience dispersed his conclusive argument was completely shattered by the scream of the newsboy, "The steamer has arrived!" Various substitutes have been suggested for lead, as for instance wrought iron, which generally makes the water rusty; galvanized iron, which is said to be objectionable on account of the zinc which is readily taken up by the water, rendering it unwholesome, though of this I am not fully satisfied; gutta percha, which is not durable; brass, which I fear is not wholesome; glass, porcelain, etc. None of these substances possess the peculiar flexibility, softness and other desirable qualities of lead, which makes it so easy to cut and bend and join and fit pipes of this metal. The problem, therefore, is to provide a pipe which shall possess all the good qualities of lead, and be free from the one great objection, namely, the danger of lead poisoning from its use. This has been achieved by the invention of the *lead incased block tin pipe*, or as some call it, the *tin lined lead pipe.* This is essentially a pipe of pure tin, surrounded by a lead pipe to which it is firmly and perfectly united by an intervening alloy or solder composed of the two metals. The water comes in contact with the pure tin surface only, and cannot therefore be contaminated with lead. That tin is harmless, it is hardly necessary to argue, as vessels covered with this metal are extensively used for culinary purposes throughout the civilized world. It has been argued that commercial tin contains arsenic; but if we can consume daily, with impunity, food which has been boiled and stewed in tin pans, notwithstanding the arsenic contained in the tin coating, I think we need have little fear of poisoning from the trace of arsenic which may possibly be present in the tin lining of this sanitary pipe. My conviction that the tin lined pipe fully realizes all that is desired as a service pipe for aqueduct water, is not based upon theory alone, as I have tested it side by side with ordinary lead pipe, and have found that waters which take up from one to two-tenths of a grain of lead per gallon from the lead pipe, are not perceptibly affected by remaining for considerable lengths of time in the tin lined pipe. It was at first thought that the expense of the tin would interfere with the introduction of this pipe, but it is found in practice that the great strength of the tin makes it possible to reduce very materially the thickness of the pipe, so that the tin lined lead pipe need not weigh more than half as much to the cubic foot as lead pipe in order to possess an equal degree of strength.

We have now fully discussed the application of water to manufacturing and domestic purposes. There is, however, another use to which we have not alluded. I do not refer to the use of water for navigation, either slack water, river or marine, nor yet to the use ot this important fluid for the extinguishing of fires, but to one of the most lucrative applications. I refer to the adulteration of milk. Investigation has shown that for every three quarts of milk brought into the city of New York, the milkmen serve out a full gallon to their customers, an average of one quart of water being added to every three quarts of milk.

This little watering operation nets the milkmen of the city, or the farmers, as the dilution is largely effected before the milk reaches the city, the nice little sum of $10,000 a day or $3,000,000 per annum. I know of no application of water which brings in so large a return in so small an area. When the milkmen heard that the health department was investigating the subject, with the view to preventing the introduction of diluted milk into the city, they expressed themselves highly delighted, averring that at present the dairymen water the milk so extensively that there is no chance left for them, and that they think that it is time they had their turn.

THE CROTON WATER.

Few cities are more fortunate in the quantity and quality of their water supply than are New York and Brooklyn. The Croton water is brought to the city of New York by an aqueduct forty-five miles long, which was completed in 1842, the water having been admitted on the 4th of July of that year. Where the water enters the aqueduct, a dam 230 feet wide and forty-five feet high was erected in the Croton river, by which the Croton lake was formed. This serves as a great reservoir or sedimentary basin. The average quantity of water supplied to the citizens of New York is 65,000,000 gallons daily. Eighty or ninety million gallons could be supplied were none allowed to flow over the dam. Mr. Jarvis, the engineer, gauged the river at its lowest period, and found its minimum flow to be thirty-two million gallons daily. In long continued dry weather, a deficiency of water occurs, for the simple reason that there is not at present sufficient storage capacity in the reservoirs. The capacity of the reservoirs is shown on the diagram:

	Gallons.
Fifth avenue reservoir	20,000,000
The old reservoir in the Central park	38,000,000
The new reservoir in the Central park	1,000,000,000
Total	1,058,00,0000

Equivalent to sixteen days supply.

Mr. Craven, chief engineer of the Croton department, carefully examined the region drained by the Croton and its branches, and found several points at which, by the erection of dams of moderate dimensions, enormous storage reservoirs could be formed. The aggregate capacity of the fifteen reservoirs which he indicated as practicable amounted to 67,000,000,000 gallons, or three years supply for the city of New York! It may be asked does a sufficient quantity of water fall in the region to fill such a series of reservoirs? I answer that the average rain-fall is somewhere in the neighborhood of fifty inches, or about thirty-one gallons on every square foot, or nearly a thousand million gallons to the square mile.

The area which is drained by the Croton river and its tributaries, or, in other words, the Croton water-shed, measures 338.82 square miles, with an elevation of from 250 to 600 feet above the sea level. One of the reservoirs planned by Mr. Craven has been nearly completed, at Boyd's Corner, in Putnam county, by Gen. Geo. S. Green. The dam is placed across the west branch of the Croton, twenty-three and three-quarter miles from the Croton dam; it is 650 feet long and sixty-four feet high, and the reservoir, when completed, will cover an area of 303 acres. It will hold 3,369,000,000 gallons of water, a quantity sufficient to supply the city fifty-five days, with its present population. This reservoir alone will carry the city through the longest drouth which is liable to occur. As the population of the city increases, it will merely be necessary to construct a new reservoir from time to time. The present supply of water is very liberal, amounting to sixty-five gallons per head daily. Imperial Rome received, however, from 300 to 340 gallons per head daily.

Few cities at the present day are as liberally provided as New York, the supply of

			Gallons.
Manchester,	in 1852,	was	50
Liverpool,	" 1862,	"	30
Edinburgh,	" 1852,	"	30
Glasgow,	" 1862,	"	50
London,	" 1862,	"	50
New York,	" 1870,	"	65
Imperial Rome			300 to 340

It has been frequently proposed of late to place water meters in every building in the city, and tax the citizens in proportion to the quantities of water actually drawn through them. This measure, it is claimed, will prevent the present waste of water. There is an air of justice, too, in the proposition to charge the customers for the water actually used. Persons may be wasteful if they choose, but they must pay for the privilege.

In my opinion, however, this proposition cannot be too strongly condemned. Pure water is hardly second to pure air as a life-giving and life protecting agent. It is the most potent servant the sanitary authorities can call to their aid. To measure out and sell, by the gallon, this bountiful gift of the Creator would be a crime against the people. It would be in direct opposition to the current of modern civilization, only to be compared, though really a much more serious act, to the tax on windows, which, not a great while ago, compelled people to exclude the blessed light of day from their dwellings, and led architects to adapt their style of architecture to the obnoxious law.

We have already seen that the water-shed of the Croton, with its 339 square miles of area, is capable of supplying water for a city of 5,000,000 of people, and that the erection of a few dams will secure reservoirs capable of storing this supply. Let the money then that would be spent in purchasing costly water meters, which are five times as expensive as gas meters, be spent in constructing one of these dams, to give us all the water we need. In truth, the reservoir at Boyd's Corner, which can easily be completed within a year, will, alone, enable the Croton department to give us all the water we need. There is no earthly reason why our water supply should be limited, unless possibly for the benefit of the owner of some patent meter. I speak advisedly on this subject, having been over the ground and seen the sources of supply with my own eyes. We should never consent to see the poor deprived of so essential a source of health and happiness, as pure and abundant water. On the contrary, there is no object for which the public funds can be more legitimately expended, than for increasing the facilities for using water, by the establishment of free public salt and fresh water baths. Why should we, of free America, in the nineteenth century, be behind Rome in the days of the Cæsars?

The importance of an abundant supply of pure water is now so fully appreciated in England, that the city of London is about to go to an enormous expense to obtain it. Two plans are under discussion; one involves bringing water from Wales, a distance of 220 miles, at a cost of £10,000,000; the other of bringing it 250 miles, from Cumberland, at a cost of £13,000,000. The purity of the Croton water is remarkable; if you glance at this diagram, you will see the quantities of the different substances obtained from one United States gallon of 231 cubic inches, in 1870:

Solids contained in one gallon of Croton water.

	Grains.
Soda	0.326
Potassa	0.097
Lime	0.988
Magnesia	0.524
Chlorine	0.243
Sulphuric acid	0.322
Silica	0.621
Alumina and oxyd of iron	a trace
Carbonic acid (calculated)	2.604
Water in bicarbonates (calculated)	0.532
Organic and volatile matter	0.670
Total	6.927
Less oxygen, equivalent to the chlorine	0.054
	6.873

These acids and bases are probably combined in the water as follows:

	Grains.
Chloride of sodium	0.402
Sulphate of potassa	0.179
Sulphate of soda	0.260
Sulphate of lime	0.158
Bicarbonate of lime ($CaO, HO,2CO_2$)	2.670
Bicarbonate of magnesia ($MgO,HO,2CO_2$)	1.913
Silica	0.621
Alumina and oxyd of iron	a trace
Organic matter	0.670
Total	6.873

On evaporating a gallon of this water, a residue of only 4.78 grains is obtained, the bicarbonates of lime and magnesia being left as simple carbonates.

The following tabular statement shows how favorably the Croton compares with the waters supplied to other cities:

PURITY OF CITY WATERS.

Impurities contained in one wine gallon of 231 cubic inches, expressed in grains.

City.	SOURCE.	Inorganic matter.	Organic and volatile matter.	Total solids.
New York	Croton, average for 13 weeks, 1867 (C. F. Chandler)	3.90	0.66	4.56
New York	Croton, average for 3 months, 1868 (C. F. Chandler)	3.31	1.14	4.45
New York	Croton, average for 6 months, 1869 (C. F. Chandler)	4.11	0.67	4.78
New York	Well west of Central park (C. F. Chandler)	38.95	4.55	43.50
Brooklyn	Ridgewood, average for 3 mos., 1869 (C. F. Chandler)	3.37	0.59	3.92
Boston	Cochituate (E. N. Horsford)	2.40	0.71	3.11
Philadelphia	Fairmount, Schuylkill (E. N. Horsford)	2.30	1.20	3.50
Philadelphia	Delaware (H. Wurtz)	2.93	0.55	3.48
Albany	Hydrant (E. N. Horsford)	8.47	2.31	10.78
Troy	Hydrant (W. Elderhorst)	6.09	1.34	7.43
Utica	Hydrant (C. F. Chandler)	5.50	0.96	6.46
Syracuse	New reservoir (C. F. Chandler)	12.13	1.80	13.93
Cleveland	Lake Erie (J. L. Cassels)	4.74	1.53	6.27
Chicago	Lake Michigan (J. V. Q. Blaney)	5.62	1.06	6.68
Rochester	Genesee river (C. F. Chandler)	12.02	1.23	13.25
Schenectady	State street well (C. F. Chandler)	46.88	2.33	49.21
Newark Jersey City Hoboken Hudson City.	Passaic river (E. N. Horsford)	4.58	2.86	7.44
Trenton	Delaware river (H. Wurtz)	2.93	0.55	3.48
London	Thames (Dr. H. Letheby)	15.55	0.83	16.38
London	Well, Leadenhall street (Dr. H. Letheby)	90.38	9.59	99.97
Dublin	Lough Vartry, new supply (Apjohn and others)	1.77	1.34	3.11
Paris	Seine, above the city (Bussey, Wurtz and Ville)	7.83	1.00	8.83
Amsterdam	River Vecht (V. Baumhauer and Van Moorsel)	14.45	2.13	16.58
Amsterdam	Deep well at the Keisersgracht	64.55	4.38	68.93

You see by this table that the Croton compares very favorably in purity with the water supplied to other cities. I will call your attention specially to the fourth water on the list, that of the well west of Central park. This water, you see, contains forty-three and one-half grains of impurities in one gallon, of which over four and one-half grains are organic matter. You will not be surprised when I tell you that this well is situated in a shanty village, where cholera was a few years ago extremely fatal.

No one who has ever examined the district of 338 square miles which supplies the Croton river, will be suprised at the purity of the water as shown by analysis. Mountains and hills of laurentian gneiss receive the rain fall, which is quickly absorbed and filtered by the pure siliceous sands and gravels, to gush out in numberless springs, feeding the brooks which bear the sparkling waters to the ponds, which serve as natural storage reservoirs. From these flow the large streams, which, by uniting, form the Croton river. This is finally expanded, by the dam at the head of the aqueduct, into a broad deep lake, the *fountain reservoir, or Croton lake*, in which the quiet waters deposit the finer sediments, and thus undergo a final purification before they are admitted to the aqueduct.

Nowhere along the streams can anything be found which can render the waters impure. Rugged rocks or bright green pastures generally border them. A few factories have been located at points where the water power is available, but a careful examination failed to reveal any pollution of the water by them.

RIDGEWOOD WATER.

Time does not permit me to give any details with regard to the water supplied to our Brooklyn neighbors. A glance at the diagram will enable you to see that the Ridgewood water is even purer than the Croton, though the difference is so slight that it would hardly make it worth while for us to emigrate across the East river for better water.

Conclusion.

Water is the great mechanical power in nature. It is the great leveler; it moves mountains and fills valleys. All our stratified rocks, sandstones, slates and limestones, were formed by the action of water. To the solvent power of water and its chemical action, we owe our useful minerals, our metallic deposits, our iron, copper, zinc, gold and silver ores, and even coal. To its physical properties its relations to heat, we owe all the phenomena of clouds, dew, rain, fog, snow and frost. It supports the plants, brings them their mineral food from the soil, and protects them from excessive heat. Animals are equally dependent upon it. Yet, after all, it is only the agent of the sun; it is sun power that make plants grow; it is sun power that moves everything in the world, and water is merely the sun's agent.

The loss of water would produce the same condition of things on the earth that we notice now in the moon. Although we have such a vast quantity of water, yet it is only $\frac{1}{24000}$ part of the earth or 0.0042 per cent. The crystalline rocks at the earth's surface now contain a larger quantity of water than this, and the moment our earth cools enough to absorb four thousandths of one per cent of moisture, the ocean will disappear. If we should lose our ocean, we should lose our atmosphere also. The openings or pores in the rocks will receive it by gravitation, and we shall have the same condition of things as exists now in the moon.

I have endeavored, as far as it is possible in a single lecture, to sketch the important relations of this all-pervading fluid, and have shown you that it is the scource of all our health and well being; but I shall have failed in my effort if I have not fully impressed you with the great truth that it may bring disease and death instead of health, and that our sources of supply cannot be too carefully studied.

SCIENTIFIC LECTURE.—V.

ON TIDES AND TIDAL ACTION IN HARBORS.

BY J. E. HILGARD, ESQ., OF THE U. S. COAST SURVEY, WASHINGTON, D. C.

DELIVERED BEFORE THE AMERICAN INSTITUTE, JAN. 27TH, 1871.

Ladies and Gentlemen.—I propose to engage your attention this evening with the subject of the tides of the ocean, and the influence exerted by tidal currents on our harbors. I shall first briefly describe the phenomena of the tides as they present themselves to an observer; then consider the physical causes to which these phenomena are due; next examine more in detail the phases of the tide on our own coasts, and finally describe the tidal hydraulics of the magnificent harbor of New York.

The most obvious change in the surface of the ocean to be noticed upon our shores, is the alternate rising and falling regularly twice in every day. Closer attention will show, that the tides of each day occur somewhat later than those of the preceding day, the average time of retardation being fifty-two minutes, and that this retardation corresponds to that of the moon. It will pass as a fair approximation to say, that it is high water at New York with a S. E. moon, or similarly for Newcastle on the Delaware, that high water occurs when the moon is south. In fact, so closely is the time of tide connected with the position of the moon, that in order to give the time of highwater upon any day, approximately, it is customary to state the time of high water on the days of the new and full moon, when the moon passes the meridian at twelve o'clock, nearly. This time is called the "establishment of the port." Then, to find the time of high water on any other day, it is only necessary to add the "establishment" to the time of the moon's meridian passage on that day. On closer examination, it will be found that the interval between the time of the moon's passage over the meridian and the time of high water, called the *luni-tidal interval,* varies with the moon's age very sensibly. Moreover, the elevation at high water and depression at low water will not always be the same, but will be greatest about the times of new moon and full moon, and least about the first and third quarters. The details of these variations will be best traced out in connection with the explanation of their causes, to which we will now proceed.

The popular explanation of the tides as depending on the law of gravitation is sufficiently simple, although the complete mathematical investigation of the subject, by which we should be enabled to predict their occurrence and magnitude for any place, is encompassed with difficulties, from causes to which we shall hereafter revert.

If we conceive the earth to be wholly, or for the greater part, covered with water, and subject to the attraction of the sun, the force of which varies inversely as the square of the distance, it will be obvious, that while the whole earth will fall toward the sun with a velocity proportioned to the aggregate attraction upon its solid portions (which is the same as if all the matter were collected at its center), the water nearest to the sun being accelerated by a greater force, and being fluid, will approach the sun more rapidly than the solid core. It will thus run from all sides into a protuberance beyond the form of equilibrium of the earth's attraction and rotation, until the pressure of the elevated mass equals the difference in the attraction of the sun. Moreover, a similar protuberance will be formed on the side opposite to the sun, since the particles of water being solicited by a less force than the solid core, will fall more slowly toward the sun, and as it were remain behind. Nor does the fact that, on the average, the earth does not lessen its distance from the sun, in the least invalidate the force of this reasoning; for the deviations from the tangential motion of the earth in its orbit are precisely those which the earth would move through if falling toward the sun unaffected by any other impulse.

The same considerations hold good in regard to the attraction of the moon upon the earth and the waters surrounding it; for although we are in the habit of considering the moon as simply revolving about the earth, it must be remembered that the attraction is mutual, that both bodies describe orbits about their common center of gravity, and that while the moon obeys the attractive force of the earth, the latter equally follows that of the former, by which it is at every instant of time drawn from the path which it would pursue if that influence did not exist, by an amount precisely equal to the fall corresponding to the moon's attractive force.

As a necessary consequence of the elevation of the water in the regions nearest to and most remote from the attracting body, there must be a corresponding depression below the mean level of the sea at points distant ninety degrees from the vertices of the protuberances, or at the sides of the earth as seen from the sun or moon. If the latter bodies maintained a constant position with respect to the earth, the effect would therefore be to produce a distortion of figure in the ocean surface (assumed to cover the whole earth), having the form of a slightly elongated ellipsoid, the two vertices of which would be the one precisely under, the other precisely opposite to the points at which the disturbing body is vertical. This, however, is not the case; for by the rotation of the earth, and the motion of earth and moon in their orbits, the direction of the disturbing forces is constantly changing with respect to any point on the earth's surface. New points arrive at every instant under the zenith and nadir of either luminary, and thus it is that waves are produced which follow them round the globe. The highest points of these waves will remain far behind the verticals of the disturbing bodies, because the inertia and friction of the water prevent the rapid change of form required, and because, although the elevating force is greatest under the vertical, it still continues to act in the same direction for some hours after the passage of the luminary, with but little diminished force.

This retardation, which would be sensible under the simple supposition of an uninterrupted ocean covering the earth's surface, becomes very considerable under the actual circumstances of the case. The depth of the sea varies so much, and the form of its basin, taken as a whole, is so interrupted by the land, that no regular progressive movement of the tide wave can take place, except in the great Southern ocean. At every point on the coast the phases of the tide will follow the periodicity of the forces causing them; but at each point, at a greater or less interval from the culmination of the sun or moon, according to its local position, and the more or less circuitous course taken by the tide wave to reach it. This interval and the actual rise and fall of the tide must be determined for each place by special observation.

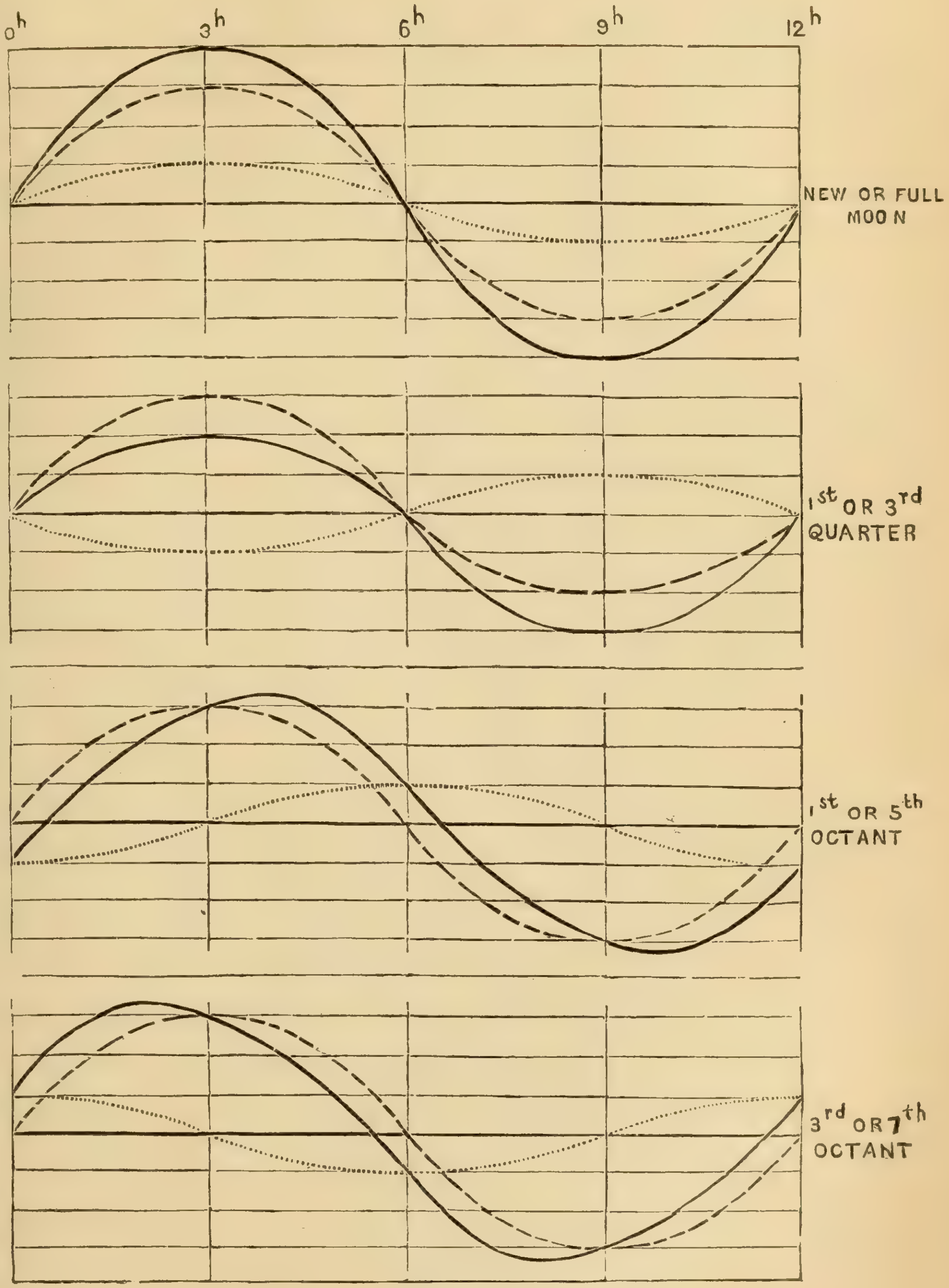
LUNI-SOLAR PHASES OF THE TIDES.

The close relations which the times of high water bear to the times of the moon's passage shows that the moon's influence in raising the tides must be much greater than the sun's. In fact, while the *whole* attraction of the sun upon the earth far exceeds that of the moon, yet owing to the greater proximity of the latter the *difference* between its attraction at the center of the earth and at the nearest or most remote point of its surface, which difference alone produces the tides, is about two and a half times as great as the difference of the sun's attraction at the same points.

SEMI-MONTHLY INEQUALITY.

We will now consider the particular phases resulting from the combination of the lunar and solar tides, and from the varying positions of those bodies. There will be two complete lunar tides in every lunar day of twenty-four hours fifty-two minutes, and also two complete solar tides in every mean solar day of twenty-four hours. These are known as the semi-diurnal tides, and constitute the principal variations of the sea level. The combined effect of these two fluctuations will be most readily understood by reference to the annexed diagram, in which the lunar tide is represented by dashes, the solar by dots, and the combined or actual tide by a full line. At the time of syzygies, or full and change of the moon, the effects of both sun and moon combine together to produce the *spring tides*, when high water is higher and low water is lower than at mean tides by the amount of the solar tide. At quadratures the high water of the sun will combine with the low water of the moon to produce a less fall, and the low water of the sun with the high water of the moon to produce a less rise than at mean tides; and we have the *neap tides*, the range of which is less than the mean range by the amount of the solar tide. Thus at New York the rise and fall at syzygies is 5.4 feet, at quadrature 3.4 feet, the former being the sun, the latter the difference of the lunar and solar tides, whence we obtain for the effect of the moon 4.4 feet and for that of the sun one foot, or a ratio of forty-four to ten. This proportion does not prove to be the same in all parts of the world, and even varies considerably in places not far distant from each other. At Boston the heights are 11.3 and 8.5 feet respectively, giving a proportion of seven to one. On the Atlantic coast of the United States it averages about five to one, while on the east side of the Atlantic ocean, on the coasts of France and England, it is in many parts as three to one. These differences are to be ascribed to the fact that the shore and harbor tides which we observe have in every instance acquired a greater magnitude than the ocean tides, in consequence of the wave having passed over a sloping bottom and have been greatly retarded by the effect of friction. A

SEMI-MONTHLY INEQUALITY



comparison of the range of spring and neap tides, therefore, will not serve as a correct measure of the relative effect of the sun and moon unless the effect of friction were taken into consideration, which we are at present unable to do for want of a complete knowledge of the configuration of the bottom.

The interval between the moon's meridian-passage and the time of high water, is subject to a variation similar to that of the height. On the day after the spring tides, the top of the solar tide-wave will be nearly an hour in advance of the lunar tide-wave, and the two waves will combine to make high water earlier than the moon's alone would bring it. It will continue to be earlier until the moon's transit is later by three hours, or in the first octant. It then falls back until it is latest in the third octant, and again advances, until, at the next spring tides, it reaches its mean period. The mean of all the luni-tidal intervals for half a month at a port its called its *mean establishment*, which is used for finding the time of high water on any given day; and tables are constructed from observations at the principal ports for finding the correction for semi-monthly inequality due to the moon's age. Thus, for New York, the mean luni-tidal interval is 8h. 13m., and its least and greatest values are 7h. 52m., and 8h. 35m. On the Atlantic coast of the United States, the range of this inequality is about ¾ of an hour; on the coasts of France and Great Britain, it often exceeds 1½ hours.

DIURNAL INEQUALITY.

The next variation of the tides to be considered is that dependent on the moon's declination. Were that body constantly in the plane of the equator, the highest points of the tide-waves would also be in that plane, and would consequently produce a series of equal tides at any place either north or south of the equator. But it is evident that, when the moon ascends to the north, the vertex of the tide-wave will tend to follow it, giving the highest point of one tide in the northern, and the highest point of the opposite tide in the southern hemisphere. Consequently, when the moon has a northern declination, the tide at any place in the northern hemisphere caused by its upper transit will be higher than that caused by its lower transit. (See diagram of diurnal inequality.) This variation in the heights has a period of one lunar day, and is called the *diurnal inequality;* it reaches its maximum when the moon is at its greatest northern or southern declination, and disappears when it is on the equator, and consequently has a half-monthly period. The variations of height from this cause produce a corresponding inequality in the times of high water. The sun's declination affects the tides in a similar manner, but the amount of the disturbance is very small, and its period extends over half a year. In long series of observations its effect is nevertheless well marked, both in height and time. The diurnal inequality, depending upon the moon's declination, is, on the other hand, quite sensible, and in many places constitutes a prominent feature of the tides, as on the Pacific coast of North America.

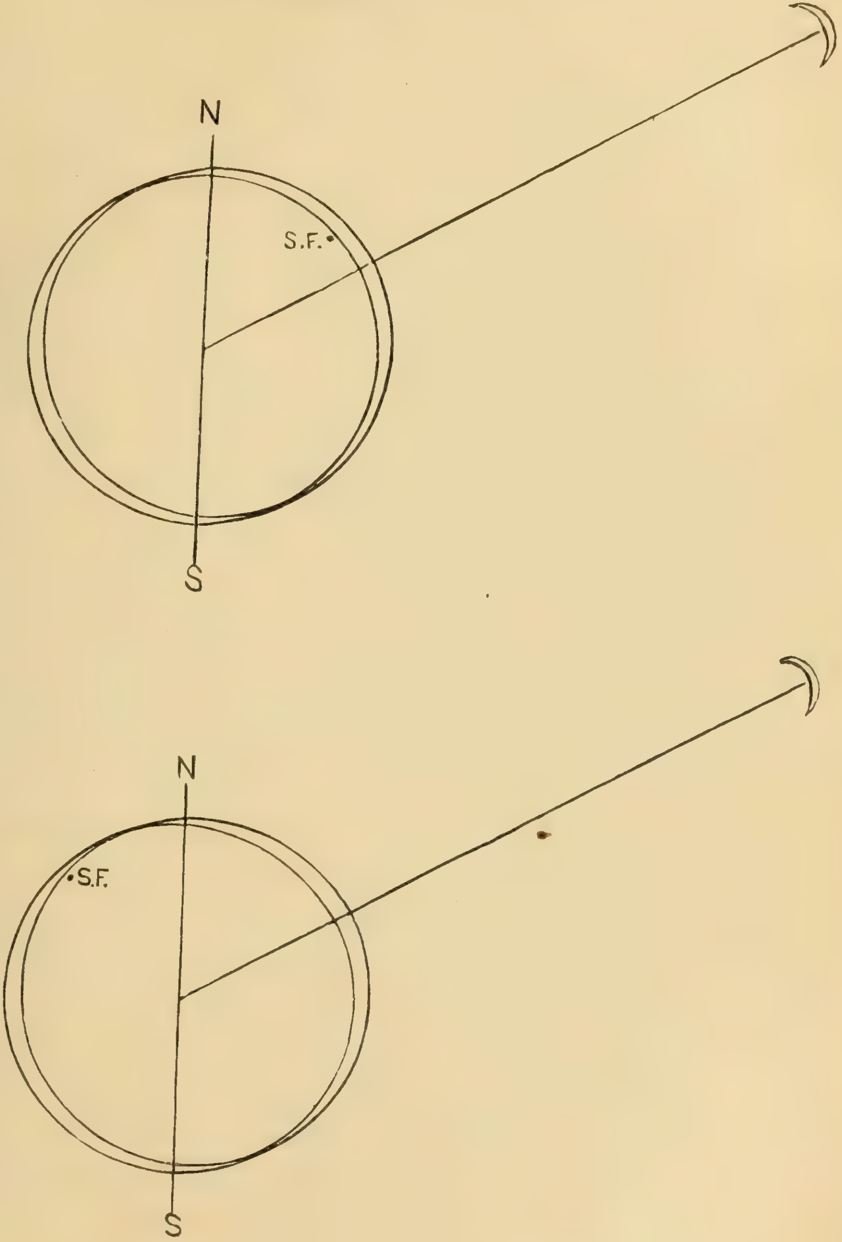
PARALLACTIC INEQUALITY.

A further cause in the variation of the height of the tides is the variation of the distances of the sun and the moon, by reason of the ellipticity of their orbits. The efficacy of a heavenly body in raising tides is shown by theory to be inversely proportional to the cube of the distance. Hence the efficacy of the sun will fluctuate between the extremes nineteen and twenty-one, taking twenty for its mean value, and that of the moon between forty-three and fifty-nine. Taking into account this cause of difference, the highest spring tide will be to the lowest neap as $59 + 21$ to $43 — 19$, or as eighty to twenty-four, or ten to three; leaving out of consideration the local circumstances of access and depth, which, as we have stated, modify those proportions in a marked degree.

TYPE CURVES.

The three principal forms of tides are illustrated in the annexed diagram, which exhibits the tides at New York, San Francisco and Galveston, for two days from actual observation. Of these, that for San Francisco may be taken as the normal type, showing the diurnal inequality, while that at New York, as at other ports on the Atlantic coast, is not sensibly affected by it. The explanation of this feature is probably to be found in the supposition that the tide-wave which advances up into the Atlantic ocean from the continuous tide in the Southern ocean, arrives on our shores twelve hours later than the direct tide-wave which crosses the Atlantic from east to west. In this way the diurnal inequality will be eliminated by the superposition of the two tides, the greater high water of the former coinciding with the lesser of the latter and *vice versa*, leaving the semi-diurnal tides of equal height.

The tide at Galveston, on the other hand, furnishes a case of the elimination of the semi-diurnal tide, leaving as a residual only the diurnal inequality. It is to be presumed in this instance that the


DIURNAL INEQUALITY

tides reaching Galveston through the straits of Florida and through the passage between Cuba and Yucatan, differ by six hours in their periods, causing the low water of one to coincide with the high water of the other, thus sensibly destroying the semi-diurnal tides, except in so far as they are unequal. This leaves a small tide outstanding, having substantially the form of the diurnal inequality, and producing the appearance the "single day tide," or one high and one low water in every twenty-four hours. This residual fluctuation is well marked at times when the moon's declination is considerable on either side of the equator, but disappears almost entirely when the moon is near the equator, since, at such times, the diurnal inequality disappears. Tides of this class have always a small range; in the Gulf of Mexico they rarely exceed two and a half feet, and the average rise and fall is but one and a half feet.

The tides on the coasts of the United States have been specially investigated by Prof. Bache, the late superintendent of the American coast survey. In connection with that work he organized an extensive system of exact tidal observations, for the purpose of ascertaining the complicated laws which govern the tides of the seas that wash our shores. It will be readily understood that in order to separate the effects of the different causes which modify the phenomena, it is not sufficient to observe merely the heights and times of high and low water, but that a continuous record of the tides is necessary, as the inequalities are constantly shifting their place and magnitude.

TIDE-GAUGES.

For this purpose a self-registering tide-gauge is used, by which a continuous curve, representing the successive changes in the height of water, is traced on paper moved by clock-work, by a pencil actuated by the rising and falling of a float in a vertical box, to which the tide has free access. The time scale is such that every hour is represented by one inch, and is pricked into the paper by points on the cylinder which moves the paper forward. The scale of heights is so adapted to the range of the tide at the place of observation, that the extreme range of the curve will not exceed the width of the sheet, twelve inches. A continuous sheet, sufficient for the record of a whole month, is put on the tide-gauge at one time. A complete description of this instrument will be found in the United States Coast Survey Report for 1853. (The lecturer illustrated the construction of several tide-gauges by means of diagrams.)

In northern ports interruptions are experienced in winter from the float-box becoming clogged with ice, and various devices have been resorted to for overcoming this difficulty. One of the most effective has been that of maintaining a temperature above freezing within the float-box by means of a simple heating apparatus. An arrangement of this kind has actually been used on the Fox Islands, in Penobscot bay. A stream of water flows slowly from an elevated hogshead through a coil in a large stove, passes down to the bottom of the float-box, and up again into another hogshead, from which it is pumped up every day by the observer into the first one. As but a small elevation of temperature is necessary, this arrangement has proved quite sufficient.

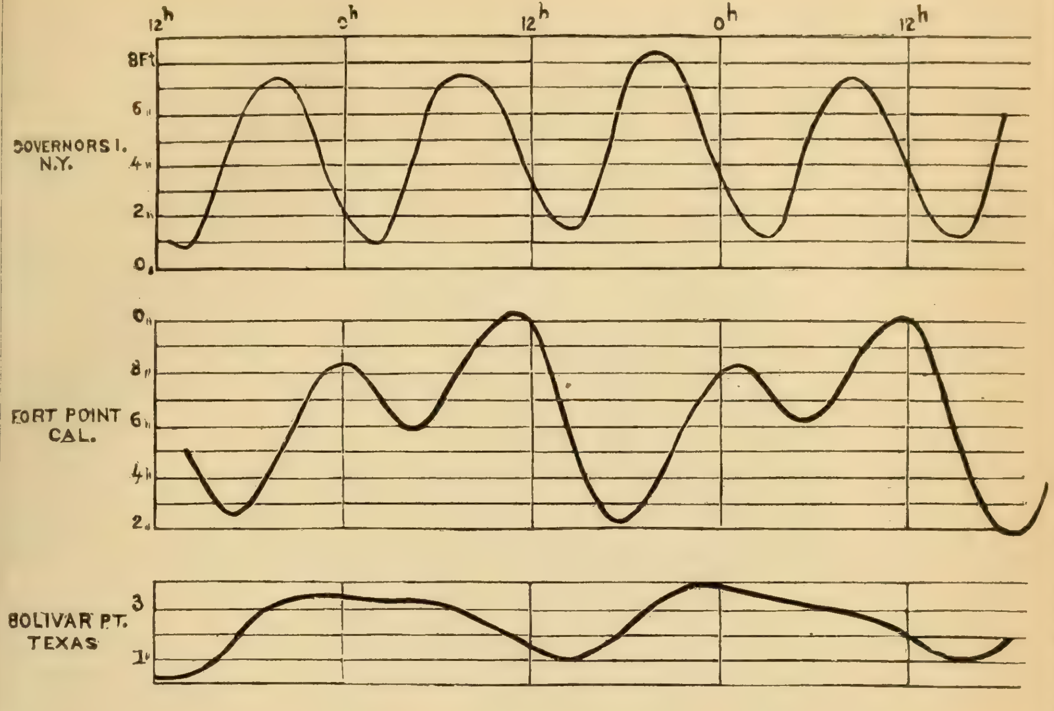
Another arrangement, devised by Mr. Batchelder, of Boston, and called by him an "Arctic Tide-gauge," is in use at Boston, and has compared well with the ordinary float-gauge. It consists of a strong iron tube, about four inches in diameter, firmly bolted to a wharf or pile. It is open at the top, and has at the lower end a nipple to which an india-rubber bag is fastened — the length of the tube being sufficient to allow the elastic bag to be always submerged at the lowest stage of the tide. The bag is supported by a suitable shelf, or cage, and is filled with glycerin, which is poured in at the top of the tube. When in this condition, the glycerin rises and falls within the iron tube in proportion to the varying height and pressure of the column of water above the rubber bag, the difference in the height of the two columns being in proportion to the difference of the specific gravity of the water and the glycerin. The parts above described insure protection against floating ice, and prevent congelation within the iron tube.

A copper tube, about three inches in diameter, closed at the bottom and open at the top, is placed within the iron tube, and floats in the glycerin: if left free, it would rise and fall with the changing level of this liquid. The length of the central tube is a little greater than the whole range of the tide.

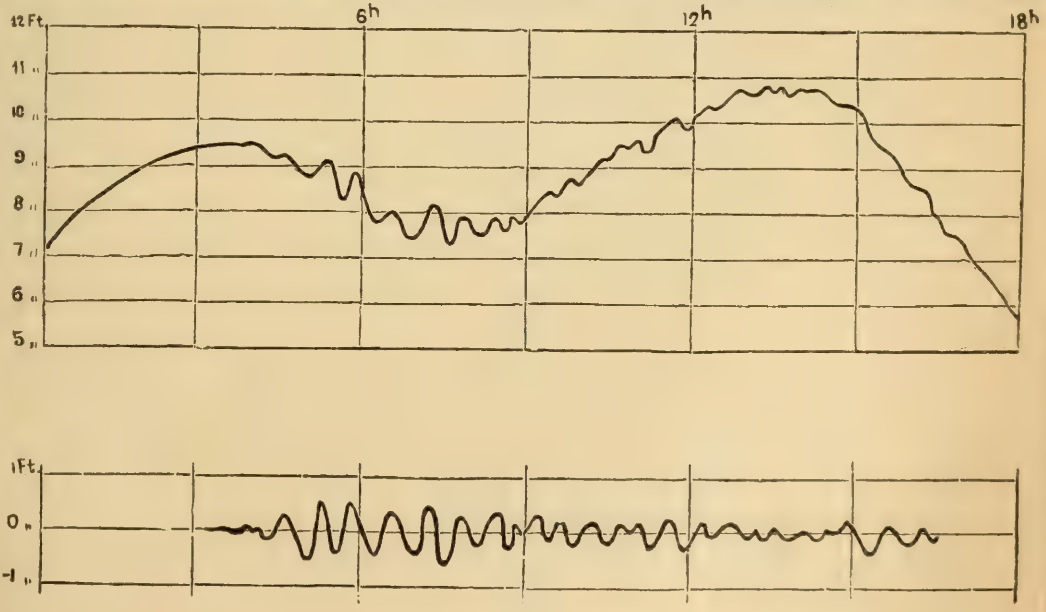
Near the upper end of the outer tube there are three spiral springs, fixed at the top and united at the bottom by a plate or disk, from which the central copper tube is suspended. From a stem fixed to the central tube or float, and moving with it, a string or chain leads over a single pulley, and gives horizontal motion to the pencil carriage of the recording apparatus.

The distance that the central tube is to move, vertically, is adjusted to agree with the required range of the pencil upon the record paper, by placing within it suitable weights.

TIDE REGISTERS



EARTHQUAKE WAVES AT FORT PT, AS RECORDED ON THE SELF-REGISTERING TIDE GAUGE.



As the glycerin rises or falls in the annular space between the iron tube and the central float, the spiral spring at the top is more or less extended, the extension being uniform on account of the cylindrical form of the float.

It is not necessary that the India rubber bag be inclosed in a perforated box, for the purpose of preventing oscillation, as it is always submerged, and the pressure upon it is equal to the weight of a column of water, having its base at the bag, and its summit at the mean level of the surface waves.

A tide-gauge for observations on an open coast has been devised by Mr. Henry Mitchell, of the Coast Survey. The graduated scale on the float is read from the shore by means of a spy-glass, the top of the tube serving as index mark.

PREDICTION OF TIDES.

Self-registering tide-gauges have been kept in operation for a number of years at different points on both coasts of the United States, in order to obtain from them the data for predicting the tides; and, as a result, tide-tables have been published by the Coast Survey for some years past, giving in advance the times and heights of high and low water for all the principal ports in the United States for every day in the year. In addition to this, the differences are given by which to find the same for intermediate ports.

A very elaborate discussion of the tides observed at Boston during nineteen years, a full lunar cycle, has been made by Mr. William Ferrel, of the Coast Survey, and has resulted in representing the actual tides with unlooked-for precision. By the introduction of the consideration of friction Mr. Ferrel has also succeeded in deriving a value for the mass of the moon, which appears to compete in exactness with the values obtained by astronomical methods. It is one seventy-seventh part of that of the earth.

EARTHQUAKE WAVES.

The tide-gauges being in continuous operation, all other fluctuations of the ocean level, beside that produced by the tides, are likewise registered. The tide curves of the western coast are frequently found indented by fluctuations arising from earthquakes. A remarkable instance of this kind is given in the annexed diagram of earthquake waves, which recorded the earthquake that destroyed the city of Simoda, in Japan, in December, 1854. The upper curve is a reduction from the tide-gauge register, while the lower shows the earthquake waves separated from the tidal wave. The time required for the transmission of the sea waves from Simoda to San Francisco was twelve hours and thirty-six minutes. The distance being 4,500 miles, the transmission of the wave was at an average rate of 360 miles per hour. The theory of wave-motion teaches us that this velocity will be attained by a free-moving wave in a depth of 440 fathoms, which may be taken as the average depth of the Pacific ocean between Japan and California. It will be observed that the crests of the waves occur at intervals of about twenty-three minutes, corresponding to a length from crest to crest of 150 miles. The height when the waves arrived at San Francisco was about eighteen inches from hollow to crest, the high waves caused by the original impulse having gradually flattened out to that form in their transmission across the ocean.

The great earthquake which occurred in Peru, in August, 1868, was likewise recorded on the tide-gauges at San Diego, San Francisco and Astoria. The fluctuation of the ocean was so great in this instance as to be very sensible to casual observation, and was noted in Australia, at the Sandwich Islands, and at Kodiak in Alaska. The data obtained from these observations, combined with the result before mentioned, indicate that the average depth of the Pacific ocean is about 1,800 fathoms.

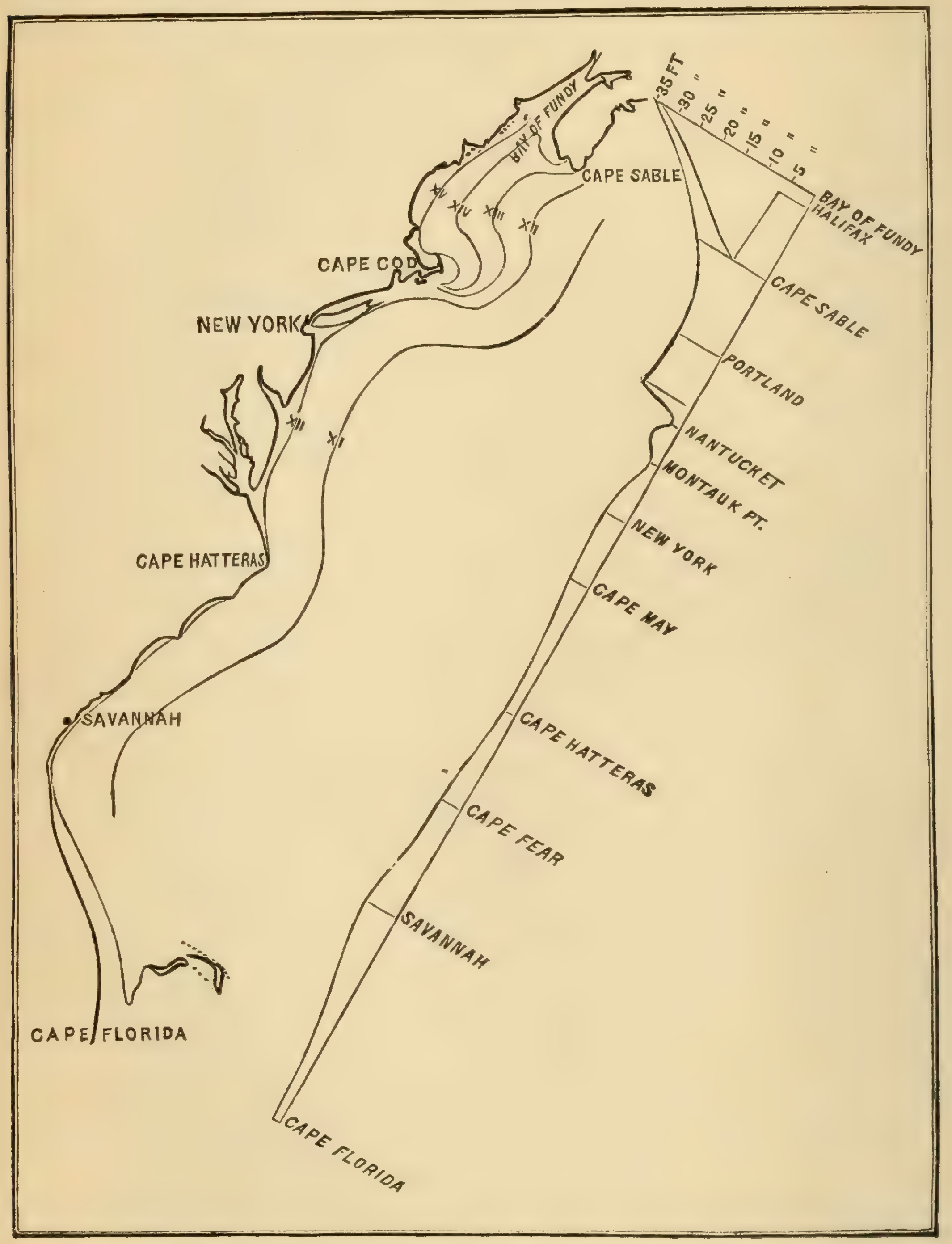
Movement of Tidal Waves.

The waves above described, originating with an impulse at one definite point, and propagated freely through the ocean in every direction with a velocity depending upon the square root of the depth of the sea, may serve as good illustrations of the manner in which tides are propagated through sounds, bays and rivers. The following table gives the rate of motion for different depths:

Depth in feet	10	Miles per hour	12.2
" "	60	" "	30.0
" "	100	" "	38.7
" "	1,000	" "	122.3
" "	6,000	" "	299.5

That movement of the ocean, however, which we have designated by the name of tide-wave, does not partake of the nature of a wave in the common acceptation of the term, but is rather to be conceived as a general movement of the water toward a point under the attracting body, and again away from it. Its periodicity is strictly dependent upon that of the attracting body. The velocity of the movement is about 1,000

TIMES AND HEIGHTS OF TIDES ON ATLANTIC COAST OF UNITED STATES



miles per hour on the equator; it extends to the bottom of the ocean, the depth of which is inconsiderable compared with the radius of the earth. It is not attended by a sensible elevation of the water in mid-ocean; and, in this respect, the characteristic of what we call a wave is absent. The movement may be likened to that of an impulse given to a very long rigid bar, as of iron. In this case, a sensible time will be required for the transmission of the impulse from one end to the other, and during its transmission the particles will successively approach to each other, by which an infinitesimal elevation and subsidence, after the manner of a wave, will be produced. In the same way the transmission of the movement through the incompressible water of the sea, is attended with an infinitesimal elevation and recession; but when the movement reaches shallow water, in approaching the shores, the horizontal motion is partly translated into vertical motion upon the sloping bottom; and it is thus that the tides attain sensible vertical height. Now, where a bay or indentation of the coast presents itself, opening favorably to the tide-wave thus developed, and decreases in width from its entrance toward its head, the tide rises higher and higher from the mouth upward. This is due to the concentration of the wave by the approach of the shores, and to the gradual shoaling of the bottom.

This effect is strikingly illustrated by a generalization of the heights of the tides on the Atlantic coast of the United States. That coast presents, in its general outline, as represented in the annexed diagram, three large bays: the Great Southern, from Cape Florida to Cape Hatteras; the Great Middle, from Cape Hatteras to Nantucket; and the Great Eastern, from Nantucket to Cape Sable, now known as the Gulf of Maine. It will be seen that the tide-wave arrives at about the same time at the headlands, Cape Florida, Cape Hatteras, Nantucket and Cape Sable, and that at those points the height is inconsiderable compared with the rise at the head of the several bays. Thus at Cape Florida the mean rise and fall is only one and one-half of a foot; at Hatteras but two feet; while at the intermediate entrance to Savannah it reaches seven feet, declining in height toward both capes. Again, at the head of the Middle bay, in New York harbor, it reaches five feet, while on the south-east side of Nantucket Island it is little over one foot. The configuration of the Eastern bay is less regular, and the correspondence of heights is not so obvious. The recess of Massachusetts bay is well marked, the increase in height reaching ten feet at Boston and Plymouth. Rolling on eastward along the coast of Maine it constantly increases, but the most striking effect of the convergence of shores is exhibited in the bay of Fundy. At St. Johns the mean height of tide is nineteen feet, and at Sackville, in Cumberland Basin, thirty-six feet, attaining to fifty feet and more at spring-tides.

When the wave leaves the open sea its front slope and rear slope are equal in length and similar in form, but as it advances into a narrow channel, bay or river, its front slope becomes short and steep, and its rear slope becomes long and less inclined. Hence arises the fact that at a station near the sea the time occupied by the rise is equal to that occupied by the descent; but at a station more removed from the sea, the rise occupies a shorter time then the descent. Thus, in Delaware bay and river, we have the following relations of the duration and height of rise and fall.

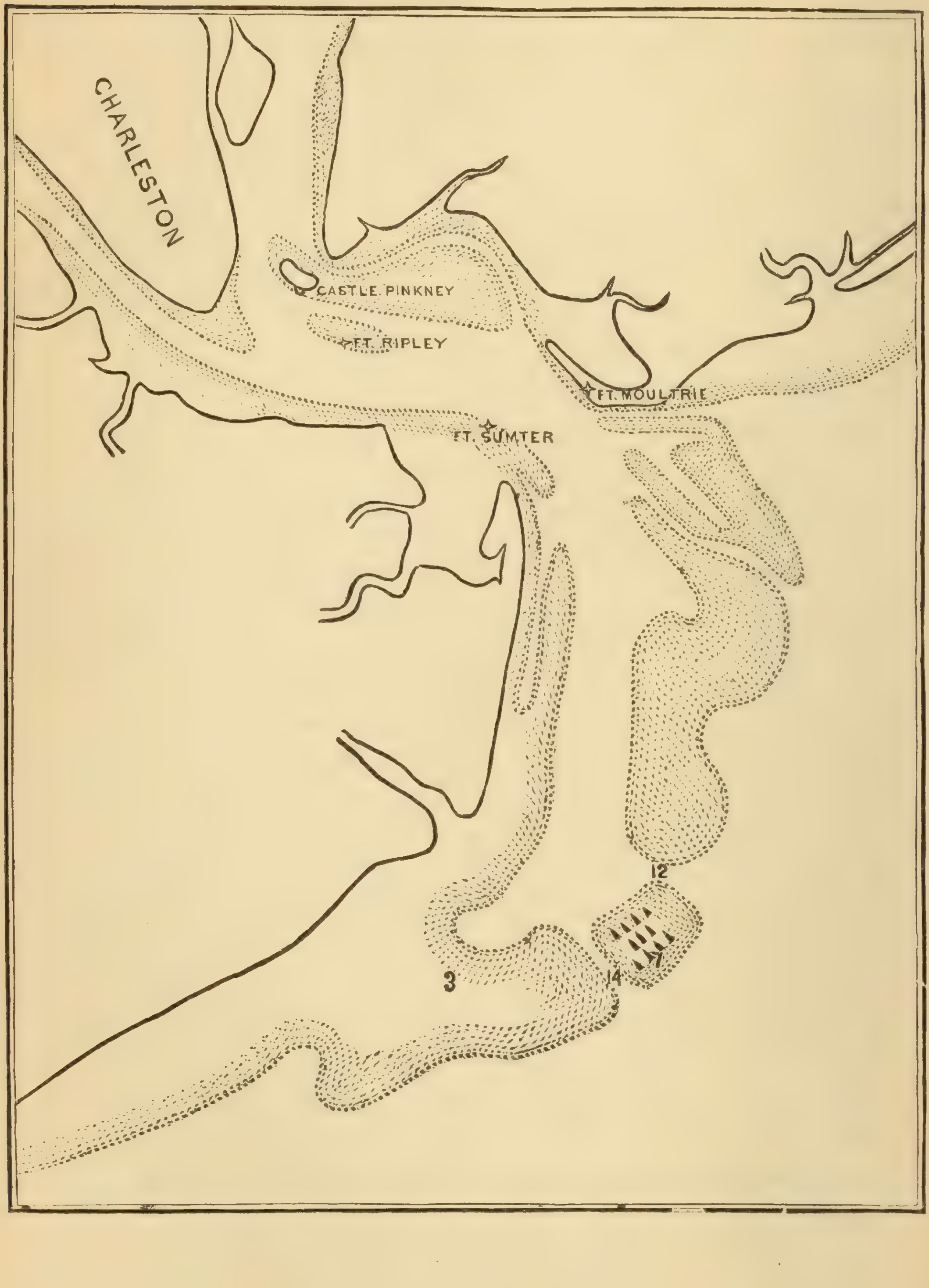
STATION.	Mean rise and fall.	Luni-tidal interval.	MEAN DURATION OF	
			Flood tide.	Ebb tide.
	Feet.	h. m.	h. m.	h. m.
Delaware breakwater	3.5	8: 0	6:18	6: 8
Egg Island light	6.	9: 4	5:56	6:30
Newcastle	6.5	11:53	5:24	7: 2
Philadelphia	6.	13:44	4:52	7:34

An examination of this table will show, beside the marked increase in the height of the tide due to the contraction of the shores from the capes up to Newcastle, a subsequent loss from friction in a narrow channel of nearly uniform character, and correspondingly a rapid propagation of the tide-wave through the deep water of the bay, and a comparatively slow movement along the narrower channel of the river. At the mouth of the bay the duration of rise exceeds that of fall by ten minutes, while at Philadelphia it is less by two hours, fourteen minutes. When the tide is very large compared with the depth of water, this inequality becomes very great; thus, in the Severn river at Newnham, above Bristol, England, the whole rise of eighteen feet takes place in one and a half hours, while the fall occupies ten hours.

TIDAL CURRENTS.

The agency of tidal currents in producing changes in the entrances of bays and harbors, is a subject of the first importance to commerce and navigation, and has received full attention in the prosecution of the American Coast Survey. The laws according to which the changes take place, require to be studied by long-continued observation, and when the change is for the worse, the means of counteracting it must be pointed out.

EFFECT OF SINKING STONE-FLEET ON CHARLESTON BAR



As on the average the same amount of water moves inward and outward with the flood and ebbtides; we might readily suppose that the same amount of material is transported either way, and that no important change would take place in the configuration of the bottom. But the operation of the flood stream is very different from that of the ebb stream. We have, as a general feature, an interior basin of some extent, communicating with the sea by a comparatively narrow passage. The flood stream, therefore, running with considerable velocity through this channel, will, as it enters the basin, spread out and become slow, depositing the sand and mud it is charged with, and making extensive flats or shoals opposite the entrance. The ebb stream runs slowly over the flats from all directions toward the opening, without removing much of the deposit, and gradually concentrates in definite narrow channels, which it scoops out, and the depth of which will depend in a great degree on the proportion of the area of the basin to the outlet, or, in other terms, on the difference of level which will be reached during the ebb between the basin and the ocean, which determines the greatest velocity and transporting power reached by the ebb stream.

On the bars of most of the sand-barred harbors on our southern coast, the place and direction of the channel are frequently changed during violent storms, when the direction of the waves happens to be oblique to that of the channel; or when the sea runs directly upon the channel, the depth of water may be considerably diminished for the time being, by the sand rolled up by the waves. But in all these cases it is found that the normal depth is speedily restored by the scour of the ebbtide, which depends upon the unchanged factors of area and form of basin, height of tide, and character of the material forming the bar.

An interesting instance of this maintenance of the depth of channels from a determinate tidal basin is furnished by the effects of the obstructions placed in the channel over Charleston bar during the war of the rebellion. On the accompanying diagram is seen the "stone fleet" sunk in the main channel, which at that time had twelve feet of water at low tide where the figure 7 indicates the present depth. There was, moreover, another channel making out more to the southward, with nine feet of water where the figure 3 indicates the present depth. The vessels were placed checkerwise in such a manner as to impede navigation while interfering least with the discharge of the water. The effect, nevertheless, was the formation of a shoal in a short time, and the scouring out of two channels, one on each side of the obstructions, through which twelve and fourteen feet can now be carried at low water. The increased water-way thus given to the ebbtide caused it to abandon the old nine foot channel on the less direct course to deep water. We have here the total obstruction of a channel which was of considerable importance to the southward trade by new conditions introduced at a point four miles distant from where the effect was produced, and we are warned how carefully all the conditions of the hydraulic system of a harbor must be investigated before undertaking to make any change in it natural conditions, lest totally unlooked for results be produced at points not taken into consideration.

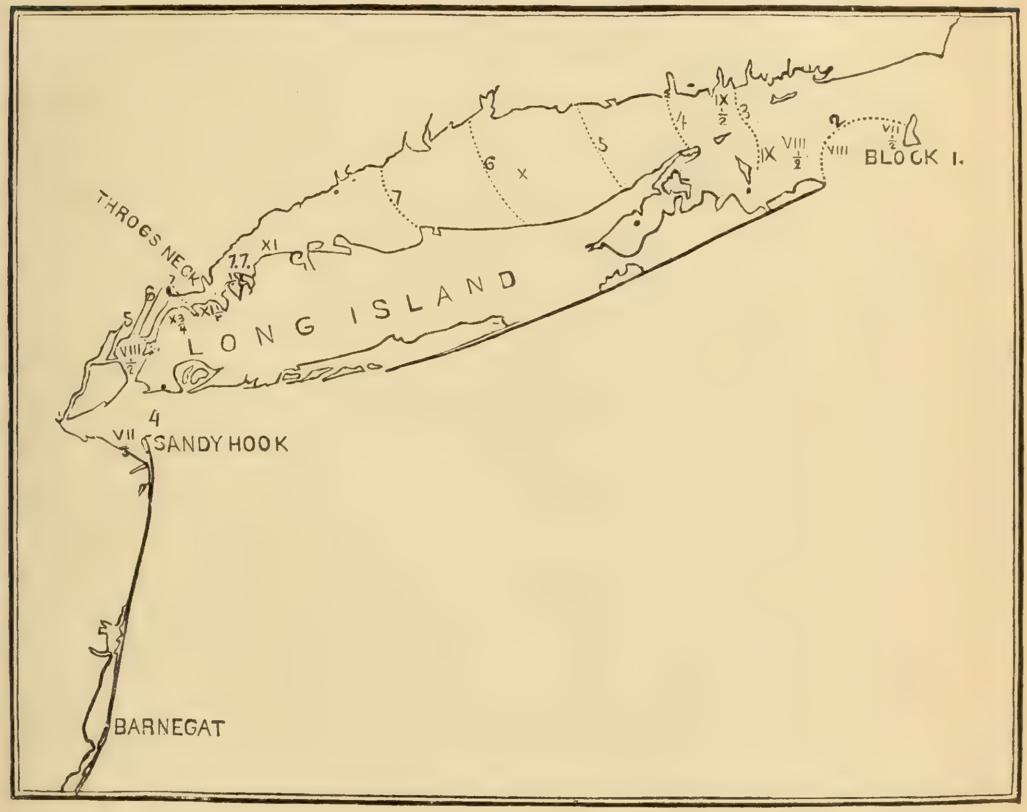
NEW YORK HARBOR.

Approaching now more closely to the consideration of the tidal conditions in New York harbor, we will examine the progress of the tide-wave through Long Island sound from the eastward to its meeting with that entering New York bay at Sandy Hook.

We see from the annexed diagram that about seven and a half hours after the transit of the moon, high water has advanced just within Block Island, with an elevation of two feet, and at the same time has just passed Sandy Hook with an elevation of four and a half feet. Traversing the sound at a rate indicated by the Roman figures, with increasing heights indicated by the Arabic numerals, it reaches Sand's Point eleven and a half hours after the transit of the moon with a height of seven and seven-tenths feet. The observed time of transmission from the Race to Sand's Point is two hours one minute, and the time computed from the depths according to the law developed by Airy, is two hours fourteen minutes; a very good approximation when we consider the irregularities in the configuration of the sound which could not be taken into account. Advancing still further, the height somewhat declines in consequence of the changes of direction in the channel and its shallowness. At Hell Gate this tide-wave is met by that which had entered at Sandy Hook, and advanced more slowly owing to the narrowness and intricacies of the channel, especially in the East river.

These two tides which meet and overlap each other at Hell Gate, differing from each other in times and heights, cause contrasts of water elevations between the sound and harbor which call into existence the violent currents that traverse the East river. The conditions of the tidal circulation through Hell Gate are such that if there were a partition across it the water would sometimes stand nearly five feet higher, and at other times five feet lower on one side than on the

TIMES AND HEIGHTS OF TIDES IN LONG ISD. SOUND AND NEW YORK HARBOR



other. In the actual case of the superposition or compounding of the two tides, the difference of level existing at any time, is, of course, much less, but the difference of one foot is often observed within the space of 100 feet in the most contracted portion of Hell Gate off Hallett's Point. Referring, now, more particularly to the diagram representing New York bay and harbor, it is important to observe that the entrance from Long Island sound is a natural depression or arm of the sea which is not changed by the forces now in operation. The tidal currents which flow through it do not change the channel, but are obliged to follow it in its tortuous course. The Sandy Hook entrance, on the contrary, is characterized by a cordon of sands extending from Sandy Hook to Coney Island, intersected by channels, which are maintained against the action of the sea, that tends to fill them up by the scour of the ebbtide from the tidal basin of New York harbor.

Unlike Hellgate passage, where permanence is the leading characteristic, the bar and channels of Sandy Hook have undergone continual changes within the brief period of our history. The advance of Sandy Hook upon the main ship channel is among the notable and important instances of the effect of tidal currents. Within a century it has increased a mile and a quarter. In the place where the beacon on the end of the hook now stands, were forty feet of water fifteen years before it was built. The cause of this growth is a remarkable northwardly current along both shores of the Hook, running both during the flood and the ebbtides with varying rates, and resulting from those tides directly and indirectly.

The best water over the bar is about two miles east of Sandy Hook light, in a direct line with the Swash channel, which is the second opening, shown on the sketch, above the Hook; the shoal lying between the main or Hook channel and the Swash channel being known as Flynn's knoll. The greatest depth over the bar is twenty-two feet at mean low water; and very nearly the same depth can now be carried through the Swash channel, which formerly was three feet shallower, but has deepened since the cross section between the Hook and Flynn's knoll has been diminished by one-third its area by the growth of the Hook. This relative change in the capacity of the channels has not, however, affected the depth on the outer bar, which, according to the principles above laid down, is dependent mainly upon the area of the tidal basin within.

The depth of twenty-two feet at mean low water, which is now maintained at the entrance, through the sands constantly thrown up by the waves of the sea, may be considered as depending upon the following elements:

1st. The large basin between Sandy Hook and Staten Island, including Raritan bay, which furnishes more than one-half of the whole ebb scour.

2d. What is called the Upper bay, including the Jersey flats and Newark bay.

3d. The North river, perhaps as far as Dobb's Ferry, maintaining the head of the ebb current, although not directly taking part in the outflow; and,

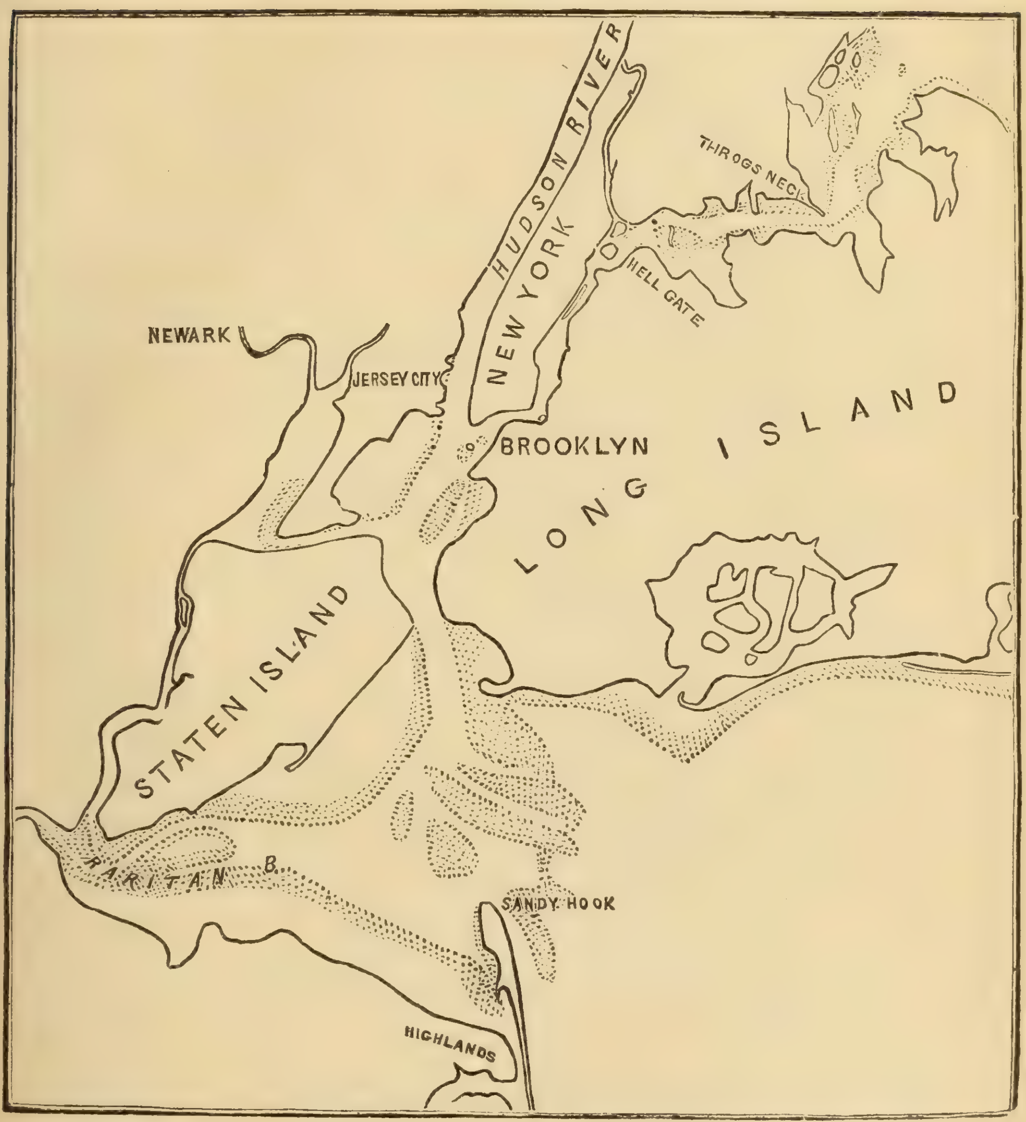
4th. A portion of the Sound tide, which flows in through Hell Gate.

The proportion of the three first divisions in producing the depth of channel, may be approximately estimated by a comparison of the areas and distances from the bar. In order to maintain the depth which we now have, it is important that the area of the tidal basin should not be encroached upon. In proportion as that is diminished the depth of the channels will decrease.

The flats, just bare at low water, but covered at high tide, form as important a part as any other portion, for it is obvious that it is only the volume of water contained between the planes of low and high water, the "tide prism," that does the work in scouring the channels. The water on the flats is especially useful by retarding the outflow, thus allowing a greater difference of level to be reached between the basin and the ocean.

When we yield to the demands of commerce any portion of the tidal territory, to be used for its wharves and docks, we must do so with full cognizance of the sacrifice we are about to make in the depth of water over the bar; and in order to form any well-founded judgment in regard to the effect of such encroachments, it is necessary to be in possession of the fullest knowledge of all the physical facts involved in the problem, and no measure of encroachment should be determined upon except in pursuance of the advice of scientific experts.

ENTRANCE TO NEW YORK HARBOR



A proposition, frequently mooted by men of enterprise, and resisted by those interested in the welfare of the city of New York, is the occupation of the Jersey flats, from Paulus Hook to Robbins Reef, for docks and wharves. Without expressing any opinion as to the relative value of the gain of accommodation for shipping and the loss of depth in the channel, I venture to say that the withdrawal of that area from the domain of the tide would occasion a loss of not less than one foot in the depth of the bar off Sandy Hook, and certainly not more than two feet.

The part which the fourth division, in our classification of the basin of New York, that of the East river and Hell Gate passage, plays in the outflow of the ebb-tide through the Sandy Hook channels, depends less upon the area involved than upon the difference in point of time and height of tide in Hell Gate already adverted to. The westerly current, usually called the ebb stream, since it falls in with the ebb stream of New York harbor, taking place when the sound tide is highest, starts from a level of three and a half feet higher than the easterly, and thus a much larger amount of water flows out through the Sandy Hook channels than through the narrows at Throg's Neck. It is apparent, then, that this portion of the ebb stream re-enforcing as it does the ebb stream of the harbor proper, at the most favorable times, performs a most important part in maintaining the channels through the Sandy Hook bar. It may be estimated that the closing of Hell Gate would cause the loss of certainly not less than three feet in the depth of those channels.

From what has been said with regard to the meeting of the tides in Hell Gate, it will be seen that the violent currents experienced in that locality are due to causes beyond our control. The dangers to navigation arising from these currents, however, by their setting vessels upon the rocks and reefs, may, in a great measure be done away with by the removal of the obstructions, in which work considerable progress has already been made. The removal of the reef at Hallett's Point, the work upon which is now in progress, will doubtless, in a great degree, do away with the eddies and under-currents produced by the sharp turn which the channel now takes at that point. It is not improbable that the successful removal of those obstructions will yet cause the sound entrance to be used in preference to the other by the fleets plying between European ports and the great commercial metropolis of America.

NOTE.—The reader who wishes to enter upon the mathematical treatments of the subject of tides, is referred to Airy's treatise on tides and waves, and to the memoirs of Whewell and Lubbock in the Philosophical Transactions of the Royal Society; and for investigations of the laws of the tides on our own coasts, to the papers on that subject by Bache and others, in the annual reports of the Coast Survey. Among the latter, the lecturer is particularly indebted to the "Report on the tides and currents of Hell Gate," by Henry Mitchell, 1867, in which the complicated problem of the tidal circulation of New York harbor is treated with great ability and success.

SCIENTIFIC LECTURE—VI.

THE EYE AND VISION.*

BY HENRY MORTON, PH. D., PRESIDENT OF THE STEVENS INSTITUTE OF TECHNOLOGY, HOBOKEN, N. J.

The last lecture of the course was delivered before a very large audience at the Academy of Music on Friday evening, February 3d, 1871. Chief-Justice Daly, first Vice-President of the American Institute, after congratulating its members on the success which had crowned the efforts of the trustees, and announcing the intention to make arrangements for another course of scientific lectures to be given next winter, introduced the lecturer who spoke as follows:

Ladies and Gentlemen: In discussing our present subject this evening, I propose to state briefly the general facts and laws of optics on which the action of the eye as an instrument of vision depends, and then to point out the peculiar adaptations which we find in the organ as it exists, while I also draw your attention to certain physiological properties of this same instrument of perception.

In pursuance of this plan, I must first give some account of that action which we call "refraction," and some explanation of its laws.

Assuming that you recognize as true the undulatory or wave-like nature of that form of motion which we call light; what, I may ask, would be the natural result if a series of waves following each other in regular succession, as we see in the case of the breakers rolling in upon the ocean beach, were to encounter obliquely the surface of some material through which their undulatory motions could be carried onward as before, but with a decrease in velocity or rate of advance?

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* The following lecture was prepared solely with the view of *interesting* an audience, some of whom were assumed to have no acquaintance with the subject treated. A few prominent points have therefore been selected for discussion and all abstruce relations have been intentionally passed over.

I think that it will occur to any of you, that the end of each wave in succession which first struck the resisting medium, being retarded while the rest of it moved freely, a swinging round of its surface would be the result.

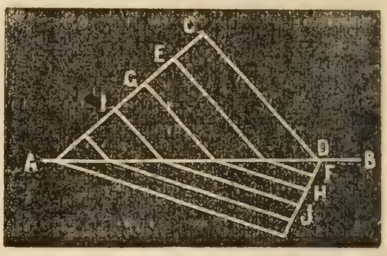


FIG. 1.

The accompanying figure indicates such an effect. AB being the surface of a block of glass, and CD EF GH IJ the successive positions of an entering wave or the simultaneous condition of a series of waves.

Now it has been proved by many experiments of the most indubitable character that light advances more slowly through dense substances, like glass and water, than through rare ones, like air; consequently, it is but natural to look for a bending of light waves on their oblique entrance into these substances; such a bending indeed as has been described above. This bending we do in fact find and we call it "refraction."

Before going further in this subject, I must explain a conventional mode of representation which we shall find it convenient to employ. In much of our study, the *direction* in which the light rays are traveling is the main point which we have to consider, and we therefore abandon the idea of successive waves, and represent *lines at right angles* to these waves, and therefore marking the *direction* in which the waves are moving, and call these lines "rays" or the representatives of rays.

They may, it is true, be regarded as representing a series of elements in successive waves; but I think we will have the most satisfactory idea if we only regard them as imaginary lines, standing for the *directions* in which the waves in their immediate vicinity are traveling.

Having then premised so much, we see that in this view of the fact we might say that a "ray" or line of light, falling obliquely on the surface of a dense or retarding medium, would be bent inward, toward a line perpendicular to the surface.

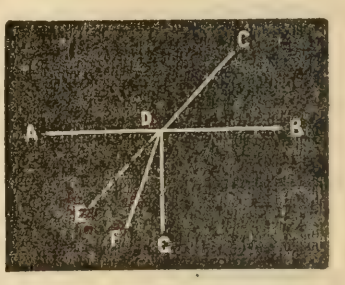


FIG. 2.

Thus AB being the surface of a piece of glass, and CD a ray or direction of light, this would not go on in its original direction DE, but would be bent into some line, DF nearer to the line DG which is perpendicular to the surface AB.

If, however, the light was passing from a denser into a rarer or less retarding medium, then the part of the waves which first entered the new surface would be *accelerated*, and, so *gaining* on the other parts, would swing the waves in an opposite direction from that taken in the case of the dense and retarding medium, and thus the ray or line of direction would be bent away from the perpendicular.

Let us now take a case illustrating this principle, or general statement of facts.

Suppose a narrow band of light-rays, such as would make on this screen the image of a clear white arrow, to be passing from the rear of the stage to the large white muslin curtain in the front. What would happen if I were to hold a bar of glass with parallel sides, so that some of the light going to make part of the image must fall upon it obliquely?

Evidently any ray which strikes the bar of glass AB in the direction CD, will be bent toward the perpendicular on entering, and will go in some line DE; but when it meets the other parallel face of the glass at E, it will be bent in turn equally *from* the perpendicular, and be so brought back to its original direction, though not to its original path or line. It has in fact been displaced or set to one side.

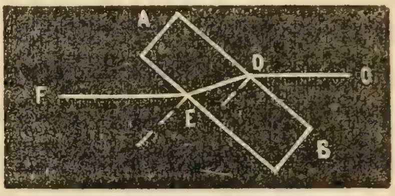


FIG. 3.

Now then we will perform this experiment. A luminous arrow appears on the screen; I hold this bar of glass between the opening through which the light passes and the screen, and as you see a piece of the arrow is cut out and set aside from the rest. I move the bar of glass, and other parts of the arrow are displaced, while those before removed now return to their places.

If in place of a luminous arrow on dark ground, we employ a dark or solid arrow on a clear space, the result is the same, only you now see the image of the bar of glass and the fingers holding it.

To carry the exhibition of our subject a step further, let us follow out the case of a ray passing through a block of glass whose surfaces are not parallel.

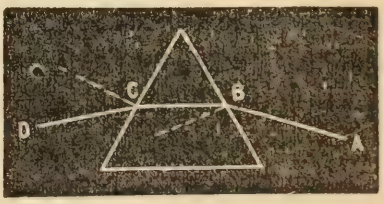


FIG. 4.

Let the ray AB fall on a triangular prism, at such an angle as is here indicated, then it will be bent on entering in the direction of the perpendicular, and will proceed in the line BC; but on passing at C from the glass to air, it will be bent *away from* the perpendicular as it was before bent *toward* it. In this case, however, the perpendiculars not being parallel as in the example of the glass bar (not to mention the differences of angle of incidence), this will not bring the ray into its former direction, but, on the contrary, will yet farther deflect it.

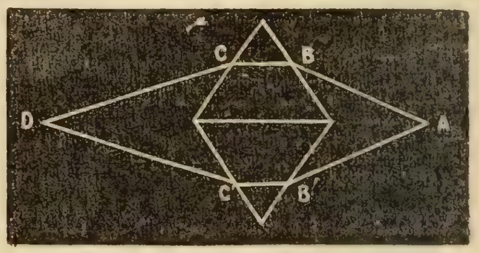


FIG. 5.

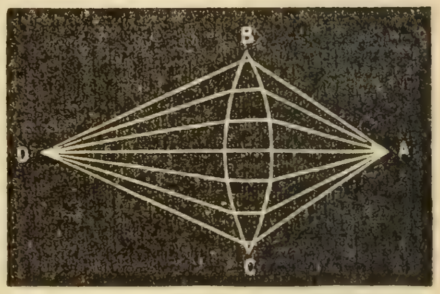


FIG. 6.

If two such prisms were set base to base, as in the accompanying diagram, it is evident that two rays setting out from A with diverging paths, might be brought together at D; or if, lastly, we had a piece of glass with *gradually changing* or curved surface as in the figure annexed, any number of rays from A meeting surfaces of different inclination in proportion to their divergence, would be brought together at D, and even if A were not opposite to the center of BC, the same thing would be true, only D would then be correspondingly displaced on the other side.

Such a piece of glass with curved surfaces so acting we call a "lens."

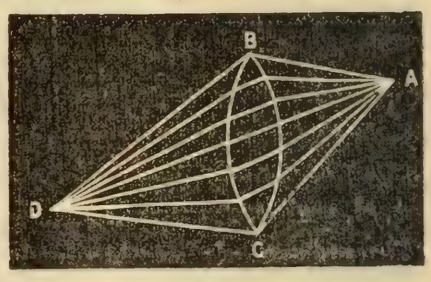


FIG. 7.

How then does a lens produce the image of an object?

Let AB Fig. 8, represent the flame of a candle emitting rays in every direction from each point. Then if we consider at first the tip of the flame alone, it is evident that rays from it would go to every part of a screen EG; as for example, in the lines AE, AF and AG, and to all intermediate points. The effect of this would be simply to illuminate the entire screen. But if a lens CD is interposed, then it will bend the various rays coming from A so that they will all meet at H (as was shown in Fig. 7), and the same thing happening for every other point in the flame, the screen will not be generally illuminated, but an image of the flame will appear at FH.

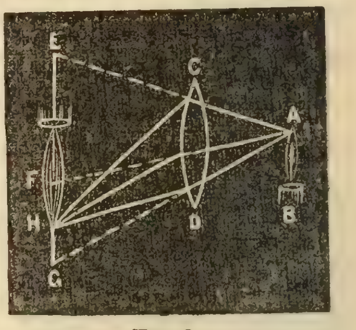
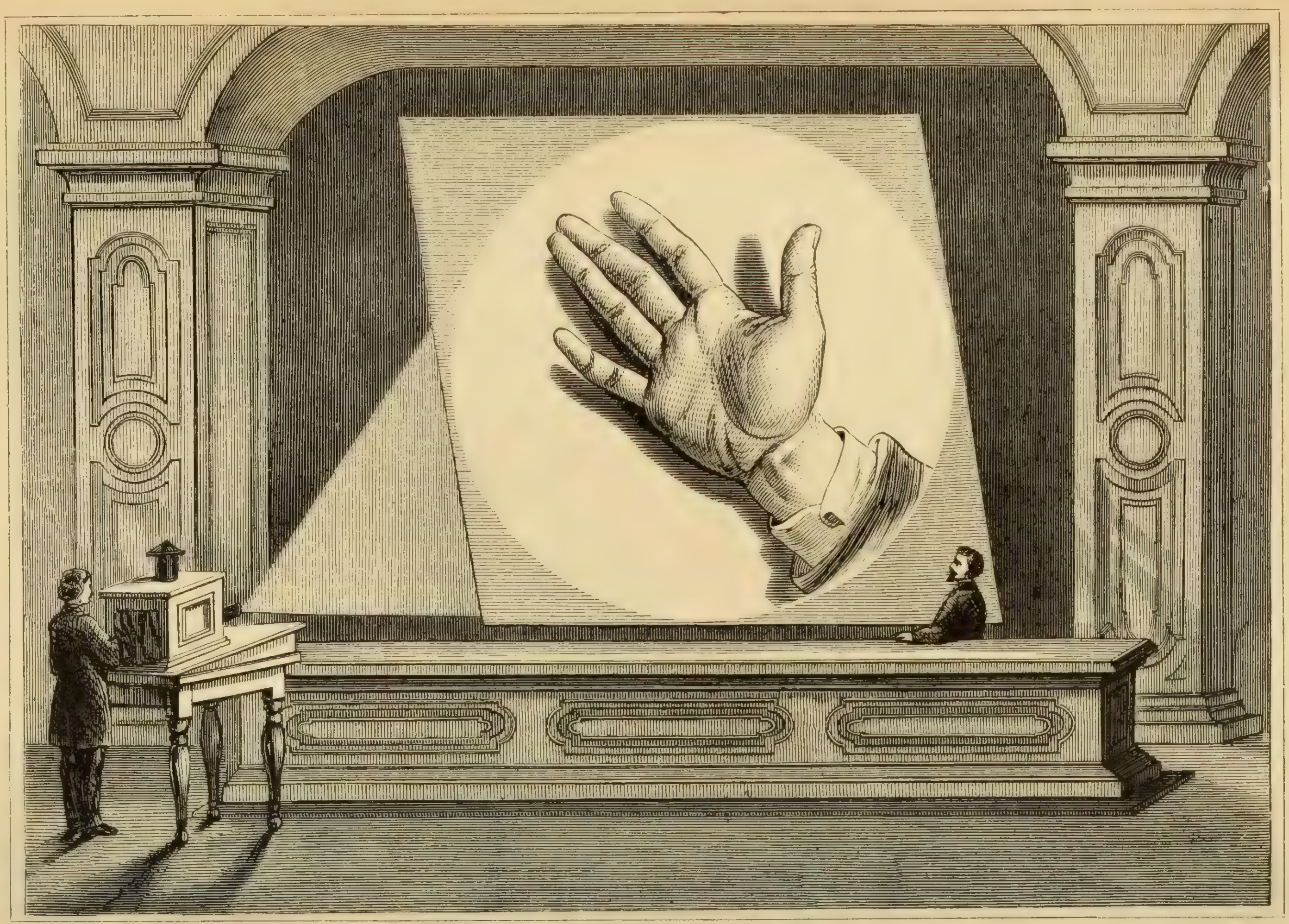


FIG. 8.

This I now show you with a candle, a lens and a screen, when you see that this perfectly clear and transparent lens shades the screen as effectually as does a solid object, with the exception of a point in the center, where appears an inverted image of the flame.



THE MEGASCOPE.

But *luminous* objects are not the only ones whose images can be formed in this manner by a lens.

Any object on which light falls scatters it away again to a greater or less extent in radial directions like those of the lines of light from the candle flame.

Thus I have here a box in which is a bright light so adjusted as to throw its illumination on anything placed within, and in the front of the box is a lens which will form an image on the large screen before you, with those rays reflected or scattered toward it by the illuminating object.

I introduce my hand in the box, and at once on the screen you see a huge hand with all the color, detail and motion of life, and by reason of these combined properties having an appearance of relief and reality which I think may well surprise you, for it is a cause of wonder to me every time I see it.

One of my assistants will, by standing near the screen, give you some standard of comparison by which you may judge of the size of this huge image, and you then see that his whole body is less than the little finger of this titanic hand. (See plate 1.)

I now substitute a burning lamp, of which you see an immense inverted image showing the flame, the glass chimney and the brass body of the lamp with wonderful distinctness.

So again, we have an apple which might make dumplings for an army, and which, when I thus cut it open, appears to be indeed a solid entity, and no mere image.

Lastly, I place my open watch in the apparatus, and you then see on the screen the works in motion and of a size rather befitting steam machinery, than clock work.

Such being the action of a lens, we will next consider in what way the eye resembles this instrument.

Viewing the entire organ in detail, we have in the first place a spherical envelop called the "sclerotic coat" covering the entire apparatus with the exception of a small opening in the rear through which enters the "optic nerve," and a curved window-pane in front called the "cornea."

A little behind this cornea is a diaphragm or partition (the "iris"), with a central orifice called the "pupil." The iris is variously colored in different individuals and so constitutes the color of the eye. Close behind the iris is a lens made of concentric spheroidal layers, decreasing in density outward, which is called the "crystalline lens." In rear of this again we find a large chamber resembling in office the camera of the photographer, which is filled with a gelatinous fluid called the "vitreous humor," and is lined on its concave walls with a coating of microscopic nerve filaments, which are the terminals of the optic nerve. These are supported by a soft layer of black surface called the "choroid coat," and the whole wall space is known as the "retina." We should have mentioned before that the space between the cornea and crystalline lens is filled with a watery fluid called the "aqueous humor."

Here, then, one can easily perceive is a system of lenses arranged in the front of a dark box, just as in the ordinary "camera obscura;" and, in fact, if the eye from a dead animal is arranged in a convenient support, and the sclerotic coat is pared away at the rear so as to make it translucent, an image of exterior objects will be seen to exist on the retina. In life, of course, the impression of this image on the nerve filaments of the retina are conveyed to the brain by the optic nerve and constitute the sense of sight. It is frequently asked, however, in this connection, since the image on the retina is inverted as is the case with all direct images formed by lenses, why do we not see all objects upside down, or at least any new and entirely unfamiliar view? I would answer simply because we do not *look at* the image on our own retina, but *perceive* that image not as an *image*, but as a *sentient impression* transmitted to the brain. The relations of direction having once been established by experience, remain unaltered and give us correct impressions independent of any question as regards the relative positions in space of the points on the retina, from which the impressions come to the brain.

What I wish especially to point out is, that the formation of an image which may be seen from outside, is a mere accident, and not an essential feature of the act of vision; and that if the picture were formed on the roof of the skull in an horizontal position, or anywhere else, it would in no way affect our appreciation (derived from experience and judgment) of the true position of the objects; for it is not the *picture* which the *eye sees*, but we ought rather to say that certain nerve filaments caused to vibrate in particular manners as regards violence, rapidity and direction of impact, convey the sense of vision to the brain, in which case it is clear that it makes no difference whether the nerve which transmits the impression of the summit of an object is located at the upper or lower part of the retina. It has only to send word that the rays are coming to it as it knows from experience they would come from the top of an object, and all is done that need be required.

PLATE II.

Fig. 1.

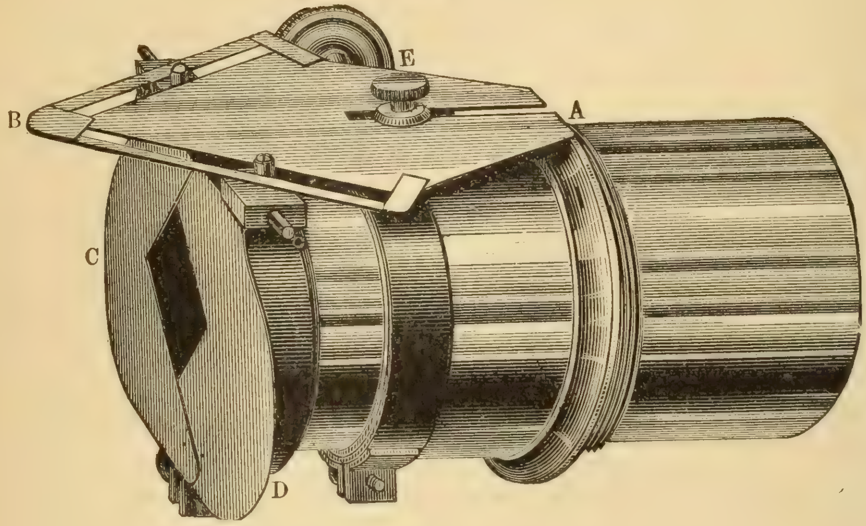
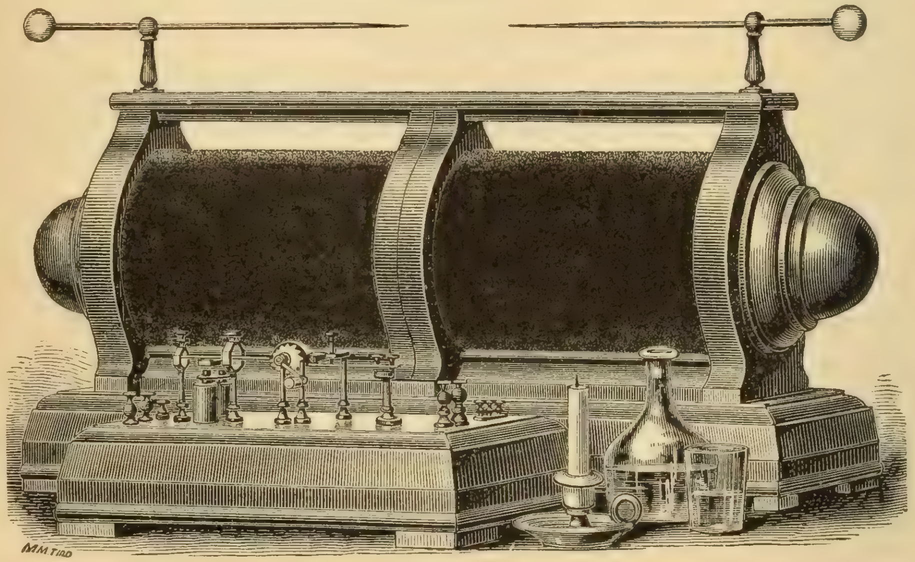


Fig. 2.



We depend in fact upon the result of experience and the conclusions of unconscious reasoning, much more than we are apt to imagine for the nature of impression of sight.

Thus it is usual to suppose that we have some positive means by which we can recognize the size and distance of objects.

Within a very limited range this is measurably true; the properties of stereoscopic vision which I need not here discuss, giving us the power of carrying out a process similar to the triangulation of a surveyor; but when a distance of some hundred feet has been passed, the angular distance between the two eyes from the object observed, or to borrow an astronomical term, what we might call its *paralax*, becomes too small for appreciation, and our ideas of distance depend solely upon a mental calculation founded upon the number and character of the objects seen between, and the apparent size of familiar objects at the point in question, while at the same time our judgment of size depends on a previous conclusion regarding the actual distance of the object regarded.

In both these respects we are very easily deceived, as every one knows from their own experience when looking at unfamiliar objects amid new surroundings, as for instance, across a level plane or a sheet of water; but I will endeavor by two methods to demonstrate to you all, now and here, that in this matter of estimate of size and distance, the eye can be utterly deceived.

The first of these arrangements is the "phantasmagoria;" for the production of this effect we have a magic-lantern mounted on a table with wheels, behind the transparent screen which we have been already using several times. At the outset, this is near the screen, and the rays coming out of the apparatus in a diverging cone, are received upon the screen before they have spread to any great extent, and so form but a small image.

If, however, the table is now rolled backward from the screen, the rays will be more and more spread before reaching it, in proportion as the distance is increased, and so the image will grow larger and larger.*

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*It is of course necessary that the object-glass of the lantern should be adjusted as the table moves; and it is moreover desirable that the amount of light should be so varied that when the image is largest it may also be brightest.

To accomplish this, I make use of the arrangement shown in Fig. 1 of Plate II made for me by Messrs. Hawkins & Wale of Hoboken. It consists of an ordinary camera tube with rack work to which it is attached, the wedge AB actuating the little pins which cause the wings CD to slide out and in on the supporting rod, and so vary the opening in front of the lens. The wedge AB is attached to the outer part of the tube by the binding screw E, and can thus be adjusted to suit various locations. The wings and their support are fastened by a clamp-ring to the inner sliding tube of the apparatus, and are carried with it by the rack work.

I will first cause the picture of a locomotive, as seen from in front, to be thrown on the screen by this movable lantern, and to add to the effect, I also cause the interior of a tunnel to be added from another stationary lantern. The locomotive first appears small and dim as if seen at the further end of the tunnel, but now it grows larger and the appearance of advancing is, as you perceive, so distinct that it is hard to believe that what we see is an image always in the same place, and one is almost induced to get out of the path of the on-rushing engine.

By reversing the order of change in size, we cause an appearance of retreat in the object, and, as you notice, we may employ quite a number of subjects, such as a statue, a skull, a floating head of a diabolical aspect, and other things for the same purpose.

In this case, then, you see how well the eye can be deceived in its judgment of distance by appropriate arrangements.

We will now pass to the next method of illustration, which has been called the "shadow pantomime."

For this effect, a light of a concentrated character is placed at the rear of the stage, close to the floor, and from thence illuminates the screen. Any object interposed near the screen, will cast upon it a shadow nearly of its own size, but if it be brought nearer to the light its shadow will increase proportionally.

I will now ask some of my young assistants to run from front to rear of the stage, and then to step over the light. The appearance, however, is as if some people started at a great distance in the rear, came running toward us, growing vastly in size as they approached, and finally, with huge leaps, sprang fifty feet into the roof overhead. The perfection of this delusion can hardly be realised until it is actually seen.

In addition to the properties which the eye possesses as an optical instrument, there are others resulting from its physiological relations, which are equally curious. The first of these which we shall consider, is that known as subjective color. Like all our other senses, that of vision, becomes obtuse to any impression when this is frequently repeated. Thus a sweet taste soon ceases to be appreciated if continuously applied; a constant uniform sound is unheard; a generally diffused odor ceases to be recognized; and even pain if not too severe may be at last unconsciously endured.

So with the eye; if every object about us is of an uniform color, we soon loose appreciation of this tint, and only realize it fully when the eye has recovered its tone by resting on other colors. This I will presently show you, but must first premise another point.

Namely, that white light contains all the colors, and that by removing any one color from it, we get an incomplete remnant which is itself a color, composed of all the others except the one removed.

Thus if we should take out the red from white light, the tints left behind would constitute green, if we took out green those left would make red, if yellow were removed violet would be the remainder, and so on.

Under these circumstances, think what would happen if an eye, which by exposure to red light had lost its appreciation of that color, were turned upon a white object. It will evidently be deficient in its perception of the red constituent, and therefore, the rest of the colors predominating, the white body will look green.

This I now show you. I cause the screen to be covered with red light all except a single circle on which white light from this ignited lime falls, and as you see the lime light is green. But now, leaving the lime light exactly as it was, we change the surrounding color to green, and then the lime light in its turn becomes red; and so on we pass it through the entire range of tints by simply altering the surrounding light. It is this action which gives some of the most beautiful of the delicate tints in a brilliant sunset, and which enables the painter to bring out on his canvass, colors which were never on his pallet.

Another remarkable property of the eye is that developed in the action known as "persistence of vision."

When a luminous impression is made on the retina, it does not immediately fade away, but endures for about the sixth of a second. If then the view of anything is interrupted and renewed again more than six times in a second, we are unconscious of the interruption, but seem to see the object continuously.

Thus I now cause a picture to be thrown on the screen, and in front of it place a wheel of card with narrow slots; this wheel being rotated, each slot allows the rays of light to go to the screen and form the picture for an instant, and then all is dark. As the card moves slowly you are aware of the successive flashes, but when a rapid motion has been acquired, the picture seems as steady in its illumination as any I have shown you this evening, though less bright.

But again, if the body making a luminous impression *moves* with rapidity, we shall see it in many places at once, because the impression made in one place will last while it has moved to another, and its apparent form may be greatly changed.

Every one is familiar with the illustration of this, furnished by whirling a stick with a burning coal on its end, and with the lightening flash. I will, however, show you a similar effect with an electric spark.

I have here an induction coil (see Plate II, Fig. 2), made for me by Mr. E. S. Ritchie, of Boston, which throws a spark in air of twenty-one inches, and penetrates three inches of solid glass. By covering this plate of glass with brass filings, we can lengthen the spark over it to many feet; and here I now cause it to spring, by paths, in many cases, six feet long, when it appears not as a moving point or spark, but as a zigzag line or chain of light, exactly resembling lightning in its form.

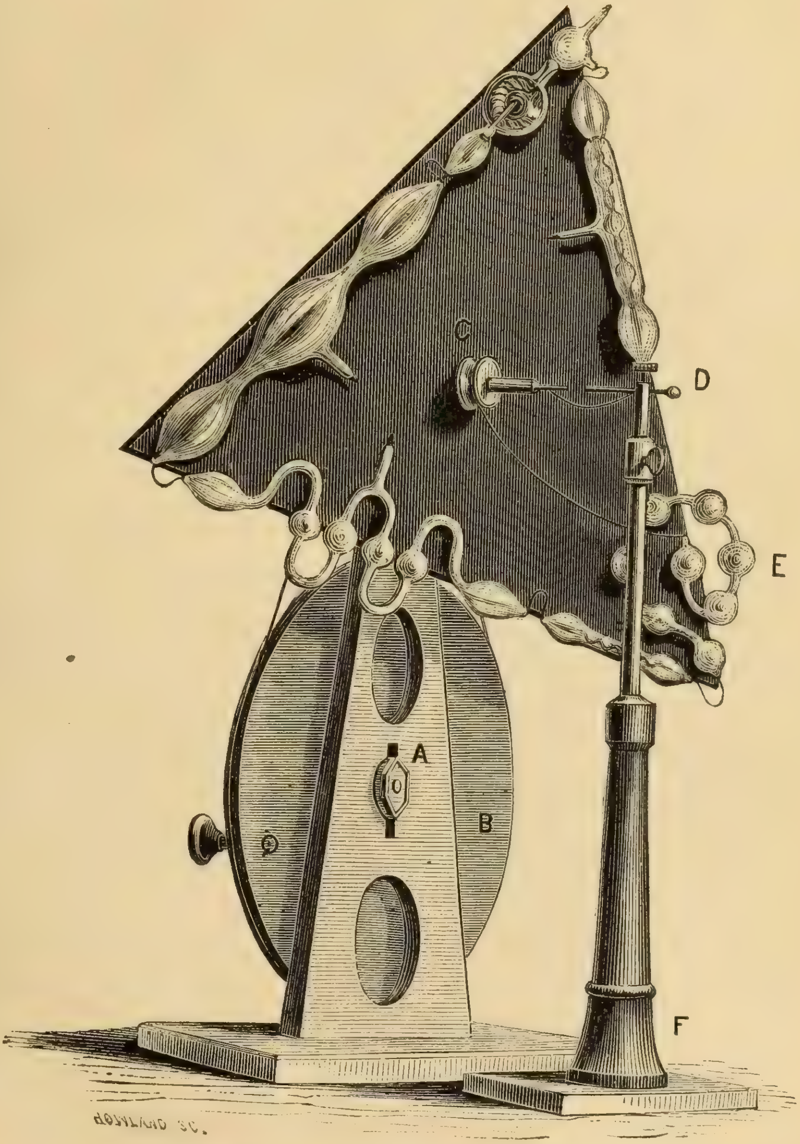
Again, if one object is made to take the place of another during a dark interval between two flashes, we do not realize the motion, but the object seems to have changed its form. Thus I have now before you a disk six feet in diameter covered with colored figures of balls and rings. The various parts of this patters are in what we may call *successive positions* as regards an individual motion of each element. The disk being made to rotate at a moderate speed, and being illuminated by successive flashes of light thrown from this lantern through the rotating card with narrow slots, the balls seem to roll around and to jump through the rings, which in turn spin about on their own axes.

In further illustration of the same subject, I now throw on the screen a disk containing all the colors of the rainbow, and, by rapid rotation, blend these together, when, as you see, the result is white; so confirming what I told you a little while since as to the composition of white light, I then substitute for this an apparatus which I have arranged on the principle of that beautiful toy the chameleon top, and you there have floods of crimson, blue and purple light pouring out in succession from a radiant center, and all resulting from the motion of a little piece of irregularly colored glass.

But one of the most charming effects produceable by the application of persistence of vision, is that furnished in the electric stars, first devised by Mr. Gassiot of London.

In this instrument we have a number of "Geissler tubes" arranged on some support admitting of rapid rotation (see Plate III), and while they are turning, flashes of electricity from the coil are sent through them, the tubes are thus multiplied in appearance until such a triangle as you here see, becomes a wreath of luminous jewelry. Tubes

PLATE III.



THE ELECTRIC STAR.

rranged in other patterns give, as you see with those other exam-les, different effects.

We have thus in the briefest manner, considered a few simple facts nd laws in relation to vision, and if this very imperfect exhibition f a fragment of the subject should have interested any of you in a urther study of the same, the object of my efforts will have been ttained.

PROCEEDINGS OF THE FARMERS' CLUB.

RULES AND REGULATIONS OF THE FARMERS' CLUB OF THE AMERICAN INSTITUTE, ADOPTED BY THE COMMITTEE ON AGRICULTURE.

1. Any person may become a member and take part in proceedings, by conforming to its rules.

2. The officers shall be a President and Secretary, to be chosen by the committee, in April, and hold for one year, and until successors are chosen or appointed. In absence of President, a chairman *pro tem.* shall be chosen by the Club.

3. Any member, for disorderly conduct, may be expelled by a vote of a majority present.

4. The Secretary shall keep the minutes of the Club and have control of the same.

5. The President may at any time call a person to order and require him to discontinue his remarks.

6. The meetings of the Club shall be held every Tuesday, at one o'clock P. M., and continue for two hours, unless otherwise determined.

7. Discussion shall be confined to agriculture, horticulture, pomology, and subjects connected therewith, and what relates to rural improvement.

8. All members of committees shall, so far as practicable, be members of the American Institute.

9. Questions or inquiries shall be made through the chair, but answers must be brief, and not lead to debate.

10. Any person desiring to speak shall rise and address the chair, and avoid personalities, and confine his remarks to the subject before the meeting; and the vote of any person may be challenged, unless a member of the American Institute.

11. No person shall speak more than twice on the same subject, or occupy more than ten minutes, unless by a consent of the meeting.

12. Particular subjects may be fixed upon for any meeting, and in that case, shall be taken up for consideration at two o'clock.

13. The usual parliamentary rules shall govern when not provided for by these rules.

Members of the American Institute are members of the Club.

May 3, 1870.

The regular session of the Club was held on Tuesday at one o'clock P. M.: Nathan C. Ely, Esq., the president of the Club, called the meeting to order; Mr. John W. Chambers filling the post of permanent secretary.

WOODPECKERS.

Mr. A. H. Caslin, Perryville, Mo., wrote: In February last I examined my apple trees, numbering 400, for the borers, which are numerous in this section, and, to my astonishment, found that twenty-seven of my trees had been relieved of the borers by the woodpeckers; and, in fact, every tree, where the borers were above the ground, the bird had removed them, and, in some instances, had gone below the surface for them. I would not kill one in my orchard for five dollars.

Dr. Isaac P. Trimble.—I have never seen the woodpecker at work so near the ground as this correspondent writes; but of the great value of the bird I have no doubt. The borer comes the first year of the tree, and works deep in the wood, seldom more than a foot above the ground. When I was a young man, the woods were full of woodpeckers; now there is hardly one of the red-headed species left. There is one variety of this bird, the best of all of them, called by some the sapsucker; it is really the demi-woodpecker. This bird finds the apple moth, which is the most destructive insect to our fruit trees. He finds it by sounding. This faculty is one of the most remarkable things in the history of birds. He is not a sapsucker. Audubon and others make no distinction between this bird and one that may be a sapsucker. He sounds the outside of the bark, hears the worm, then bores in with unfailing certainty and kills him. He is the most useful of birds.

Mr. Adrian Bergen.—I believe in all the woodpeckers. I can well remember how we used to shoot them, but I have learned now how useful they are. I think I have seen them at work as near the ground as this correspondent remarks.

Mr. F. D. Curtis.—I had a pear tree near my house, and the woodpeckers were at work upon it every day. I was advised to shoot them, but I said let them alone, they are not hurting the tree. I was told that they were sucking the sap. I thought differently; they bored the tree from roots to limbs. The tree died, and I cut into it and found that it was literally alive with grubs. They were too many for the birds. I never saw any other bird that was as useful.

I vote to the woodpecker more wisdom than I have myself. The woodpeckers did all they could to save my tree, but it died for want of breath, strangled by the mass of grubs.

Dr. Isaac P. Trimble.—I never knew the holes made by the woodpecker to injure any tree; it may a pine. Their holes are the most numerous in the fall. No apple tree is apt to be injured that is not perforated above the graft. I cannot say too much of this most useful of all American birds. I think it is entitled to what few grapes and cherries it eats, nothing in value compared with the good they do. I don't feel like calling any man my friend who shoots the woodpeckers.

Mr. Wm. Lawton.—I can corroborate all that has been said. I regard the woodpecker as a friend, and the most useful bird we have. There is one variety of woodpecker that does peck around the tree in a circle. I have had some of my apple trees so treated, but none of them have been injured by it. They are now as thrifty as any in the orchard.

Prof. H. E. Colton.—In the south we have all the varieties of woodpecker spoken of. I never knew them to injure a tree; in fact they are seldom seen on live trees. Some twelve or fifteen years ago, a species of worm killed millions of pitch-pine trees in North Carolina. Almost before they were thoroughly dead, these trees were full of woodpeckers, searching for the worms. I cannot call to mind an instance when I ever saw one on a live pine tree. We have the demy or gray species, also the red-headed large and small. One seems as good as the other for worms, the smallest rather more industrious.

Dr. Trimble.—The North Carolina people shot them, thinking it was them that killed the trees.

SALT AND LIME.

Mr. W. B. Harland, Stevensvill, Ind., writes: How will it do to put a spoonful of lime around each cabbage plant, to protect it from the cut-worm or soil which is mostly decomposed granite and contains no lime? Also, would salt thus applied injure tomatoes?

Mr. Horace Greeley.—I have put salt around cabbage, but never around tomatoes. I do not think the effect would be good.

SUMAC.

Mr. B. R. Lummis, Sodus Point, N. Y.—Will you please inform me if there is a market for American sumac used for dyes. It grows wild in this section. Visitors to the islands in this bay, on which the sumac grows, have stated that it was of value, but I have been unable to get trustworthy information as to it. My object is for the public good.

Mr. Horace Greeley.—I picked sumac fifteen years ago. American sumac is not considered as good as that from Sicily, and that grown in the northern States is not so good or so valuable as that from the south. The leaves only should be picked.

Mr. J. M. Gray.—There is a dyeing establishment on Staten Island which uses the berries in large quantities. Application to any of them will give the information.

Dr. J. V. C. Smith.—I also understand that the berries are extensively manufactured into Russ wine, a valuable tonic.

Rev. Mr. Diehl.—The best sumac comes from Sicily, and is worth about $110 per ton. It contains more tannin, and is better prepared than the American.

Dr. A. H. Smith.—I looked into the sumac business during a trip to Richmond. It is used for tanning morocco, and is said to contain more tannin than the Sicily, though not so well prepared, having pieces of twigs in it. The value is in the amount of tannin it contains. It is used here and also exported.

Prof. H. E. Colton.—Three or four years ago I had many samples of sumac sent me, and many inquiries about it from the south. I went through the leather and morocco establishments down town, and learned of them that the only fault with southern sumac, was its preparation. The people would let pieces of twigs get in among the leaves, and they are of no value. This error has been corrected to a great extent now, and southern sumac is actually exported, then brought back and sold as Sicily sumac. All southern sumac is classed as Virginia, though a great deal, perhaps most of it, comes from North and South Carolina, or Georgia and Tennessee. By far the greater part comes through the port of Norfolk. The leaves are gathered just before the berries ripen, then dried and ground fine. The berries when ripe, if picked and dried, make a valuable dye; but I am told if the leaves are picked the berries are not worth much. There has sprung up at the south a large trade in it, and much money has gone to that section for a product which grows spontaneously, and hence costs little labor, etc.

Agriculture of New Mexico.

The President announced that Dr. A. H. Smith had been invited to deliver an address upon New Mexico, its agriculture, etc., and as that gentlemen was present, the Club would now be pleased to hear him.

Dr. Smith spoke as follows: New Mexico lies between thirty two and thirty-seven degrees north latitude, and between twenty-six and thirty-two degress west longitude, its northern border being on a line with Norfolk, Va., and its southern boundary on a line with Savannah. It is bounded north by Colorado, east by Texas, south by Texas and Mexico, and west by Arizona. Though the territory, as represented upon the map, comprises a large area, the really habitable portion is confined to a narrow strip running from north to south on either side of the Rio Grande. The reason of this is to be found in the fact that sufficient rain does not fall to sustain any but a peculiar vegetation, and that, therefore, agriculture is possible only where the vicinity of streams affords facilities for irrigation. Bordered both on the east and west by vast plains nearly a thousand miles in width, where there are no considerable streams to impart moisture to the atmosphere, New Mexico possesses a climate of peculiar dryness. The annual fall of rain does not average ten inches in the southern part of the territory, or more than eighteen inches in the more elevated regions of Santa Fe, while in the vicinity of New York the annual fall is about forty-five inches. In consequence of this extreme dryness, there is an entire absence of dew, except occasionally on the margin of streams. Springs occur but seldom, and are greatly prized. Routes of travel are located in reference to them, the distance to be traversed being often very much increased by the deviations from a direct course required to obtain water.

It would be supposed that such extreme dryness of the atmosphere would be fatal to all vegetation, except in the immediate vicinity of water. But such is not the case. On the elevated plateaus, where no rain falls for months, and the soil seems utterly destitute of moisture, an immense variety of different families of cactus grow with the utmost luxuriance, and a species of fine, hard, wiry grass attains the height of twelve or fifteen inches, and affords most excellent pasture. In the spring and early summer this grass or *gramma*, as it is termed, is green and slightly moist, but by midsummer it has become brown, dry and brittle. In this state it has lost none of its nutritive properties, it being almost equal to grain in its fattening quality. Its hard and wiry character destroys the edge of a scythe, and it is, therefore, usually cut with a hoe. If water can be obtained for stock, they will thrive wonderfully on this grass the year round, the climate being so mild that they can remain out all winter.

In some localities there are large tracts covered with a species of dwarf thorn-locust, called mesquit. The fruit of this shrub, which is contained in long slender pods, is very nutritious, abounding in gluten, while the pods themselves contain a large amount of saccharine matter. During the autumn this is a very valuable resource, and all kinds of stock revel in the transient luxury. The beans are sometimes collected and preserved for use in the winter, but they are apt to become filled with small, brown worms, which, when swallowed by stock, pierce through the intestines, and produce fatal inflammation. Another specie of the locust family growing to the dimensions of a small tree, produces what is known as the screw-bean or *tornillo.* The pods, which occur in clusters, are spiral in form and contain minute seeds. They are fully as nutritious as the mesquit bean, and can be kept without becoming wormy.

Were it not for the continual depredations of the Indians, New Mexico could supply the whole United States with wool; sheep doing remarkably well and appearing to be much more independent of a frequent supply of water than cattle. But away from the immediate vicinity of the towns, stock is not safe for a day, and the herder's life is in constant jeopardy. Still, notwithstanding this and the fact that until within the last two or three years, all the wool sent to the "States," has to be carried in wagons a distance of from 800 to 1,100 miles; the clip of New Mexico has very sensibly affected the market in the east. The prevailing breed of sheep are rather small, and the wool very coarse. It is customary to sell the wool by the fleece, the purchaser to do the shearing. The usual price is about six cents a fleece. It does not pay at this rate to spend time in careful shearing, and therefore, the legs and neck are generally left with the wool on, giving the animal a very dilapidated and demoralized appearance. The cattle are also small, with long, slender limbs, and when used for draught are remarkably fast walkers. They are not of a kind adapted for beef, and the disadvantages under which they are grazed prevent their fattening, so that good beef is almost unknown. The horses resemble the mustangs of Texas. Though small, their power of endurance is very great, and their speed remarkable. They are reserved almost entirely for riding. The mules are also very small, and many of them scarcely larger than donkeys. Great numbers of them are employed for freighting purposes, the only commerce with the world, 800 miles distant, being by trains of wagons drawn by mules or oxen. A mule team consists of either eight or ten animals, and the average load of one of the immense wagons, or prairie schooners as they are sometimes called, is 5,000 pounds.

As already remarked, the soil can be cultivated only along the borders of streams, where the topography of the country favors irrigation. The system of canals by which this is effected is too extensive to be carried out by individual enterprise, and is therefore the work of the community. A point on the stream is chosen above the tract to be irrigated, and where the banks are somewhat elevated. A slight dam built at this point throws the water into a canal leading to the locality to be overflowed. This canal is kept as nearly on a level with the stream above the dam, as is consistent with a very gentle current. Hence soon after leaving the dam the bed of the canal is in main parallel to the stream, but as far from it as the formation of the country will permit, inasmuch as it is the only land included between the two which can be irrigated. Branch canals distribute the water as required. Although bottomland is, as a rule, very level, yet there are slight irregularities of the surface which render the problem of overflowing all portions, evenly a somewhat difficult one. Hence, the skill demanded for the successful practice of irrigation is considerable. The higher portions of ground are included in ridges, eight or ten inches in height, made with the hoe. The water is let in the basin thus formed, and when the ground has become saturated to the desired extent, the ridges cut through, and the water allowed to flow into another basin similarly prepared, on a lower level. In this way the process is continued until the entire surface has become sufficiently moist. Usually, from three to four inches depth of water are employed at each irrigation, and the process is repeated three times between sowing and harvest. The use of the water by the different parties entitled to it, is regulated by stringent territorial laws, and each township has an officer called the "alcalde of the water," whose duty it is to see that the canals are kept in proper order, and to settle all questions growing out of the subject of irrigation. His powers within the limits of his sphere are equal to those of a justice of the peace. He may summon a jury and compel the attendance of witnesses, as is usual in a justices' court. He is required to keep a list of the persons within his jurisdiction who are entitled to water, and to decide upon the order in which they are to be supplied. Tapping the canal out of turn is severely punished, and is considered more disreputable than any other theft.

Like all people who are ignorant and at the same time indolent, the New Mexicans are inclined to rely very much upon superhuman aid, and to attribute want of success to some unfavorable supernatural agency. Nearly every department of industry is supposed to be under the control of some patron saint, who, in his lifetime excelled in that particular line. On account of public alarm, on account of unusual lowness of the streams, the priests appoint an especial day of supplication to the saint, when regular ceremonies are repeated.

The plows used in New Mexico resemble those employed in Egypt 3,000 years ago. They are made entirely of wood, and are of the simplest possible construction. A piece about two feet long and four inches square is cut from the body of a tree in such a way as to include the origin of a limb of convenient size to serve as a handle. This block, sharpened at the extremity, is at once share, mold-board and landside. The attached limb, cut off at a proper length, is the solitary handle. It only remains to frame the end of a long pole into the angle made by the handle and the nondescript base of the implement, and the plow is done. The pole which serves as a beam is long enough to reach to the yoke, where it is secured by a thong of rawhide. With this implement it is, of course, impossible to do anything more than scratch the surface of the ground. But the soil being alluvial and soft, the roots of the grain strike down into it readily, the object of plowing being merely to cover the seed, and not to loosen the earth beneath. The seed is dropped from the hand into each furrow, and is supposed to be covered by the plow in the next round. But in reality the covering of the seed is chiefly affected by the irrigation which immediately follows. It is stated that American plows have been tested in New Mexico, but with disastrous results, as they broke up a sort of hardpan which lies a short distance below the surface, and left the ground in the condition of a sieve, through which the water soaked away at once, and left the surface without moisture. Granting this objection to hold good, the miserable plows of the country might be replaced with advantage by the cultivator harrow, which, beside operating more rapidly, would stir the surface better and have a tendency to keep down the weeds.

The principal crops raised are Indian corn, wheat and beans. The yield is fair, but not in proportion to the richness of the soil, which does not become exhausted, owing to the constant addition of organic matter brought by the water used in irrigating. For some unexplained reason it is impossible to raise potatoes, the vines growing very luxuriantly, but producing no tubers. I have paid twenty cents a pound in silver, for a few potatoes brought from Chihuahua, and sold as a rare luxury. Grapes attain to great perfection, as might be expected in such a climate. I think I have never tasted any elsewhere which possessed so much body. Considerable wine is made, which has the richness and body of port, with the delicate flavor of the sweet Hungarian wines. The manufacture of this wine shows a considerable fertility of resource on the part of the natives. The grapes are bruised in a wooden trough by means of a heavy block of wood attached to the end of a spring-pole, and made to play up and down by a man who sets astride the pole and "teeters." Barrels being very scarce and expensive, an ingenious substitute is employed. Four stout sticks, about three feet in length, are lashed together with rawhide, so as to form a square frame. This is supported at each corner by a crotch driven into the ground. The next step is to take the fresh hide of a beef, and having trimmed around the edges to sew the latter firmly to the frame with thongs of rawhide. As the hide stretches it forms a large pouch, which hangs suspended from the frame. The cover is composed of sticks placed closely together, upon which straw is laid, and the whole covered with three or four inches of earth. All this trouble is taken to save a few feet of boards, sawed lumber being exceedingly scarce and difficult to obtain. These pouches may be used year after year, and do not seem to impart any unpleasant flavor to the wine.

Rude as are the plows already described, they are not more so than other agricultural implements. The carts, for instance, are the most perfectly absurd structures which human ingenuity could devise. To make a cart-wheel, a tree two feet in diameter is cut down, and a length cut from the trunk equal to the diameter of the proposed wheel. This is then hewn away with an ax, on both sides, until a plank three inches in thickness remains. A portion, however, of the middle of the plank is left with a thickness of a foot or more to constitute the hub. A hole about three inches in diameter is made through this to receive the arm of the axle. To complete the circle two pieces of crooked limb are selected which are dressed so as to form as nearly as may be the segment of a circle. These are fastened at each end to the edges of the plank by means of wooden pins, and the wheel is done. The axle is made entirely of wood, and is lashed to the bottom of the body in such a way as to be easily removed and replaced by a new one. When starting on a long journey it is usual to take three or four spare axles to replace those worn out. The body of the cart is merely a sort of crate made of twigs bound together with rawhide. The whole affair does not contain a particle of iron. A cart of this kind is usually preceded by six oxen, five to draw the cart and one to draw the load. Nothing being used to lubricate the wheels, their groaning may be heard to a great distance, uttering the pathetic appeal, grease, grease, grease,

grease. Oxen are yoked by means of a stick placed behind the horns, and secured to them by long strips of rawhide applied in numerous turns of the figure of eight. This is a cruel arrangement in any case, for if a weight is to be borne, the leverage at the end of the neck renders it very oppressive; while in hauling, the line of draught is so much above that of the spine that the neck is bent upward, and the nose elevated in a manner that must be exceedingly tiresome and painful.

I have had occasion in this paper to speak frequently of the use of rawhide. The value of this article to the Mexican ranchero is beyond computation. It takes the place of chains, ropes, nails, screws and bolts. If this resource were suddenly cut off agriculture could scarcely proceed. By its aid the farmer is enabled to dispense almost entirely with the assistance of the carpenter, the saddler, and the blacksmith. No mortice holds its tenon more firmly than the lashings of rawhide, applied while wet, and acquiring when dry the rigidity of iron, bind together the joint which they embrace. No system of chains, rings and clevises, could connect the yoke more efficiently with the simple plow than does the rawhide thong. Rawhide is everywhere, and furnishes the means for all connection, matrimonial excepted. It forms part of the cradle in infancy, and the bier of age.

As may be inferred from what has been already said, agriculture in New Mexico is carried on under great disadvantages. The labor expended upon irrigation is immense, and though there are some advantages in being able to control the supply of moisture, they do not compensate for the outlay which the system necessitates. It is only because of the isolation which prevents the products of more favored localities from coming into competition with those of the country that agriculture is at all remunerative. Except in the case of wool, there is, of course, none but a home market, but, as there are always a considerable number of troops in the territory, and also parties engaged in mining, the demand is usually sufficient to insure a fair price for produce. Labor is cheap compared with the cost of living. A dollar and a half a day is considered large wages, when flour is twenty cents a pound, and other necessaries in proportion. From this it may be inferred that the condition of the laboring class is not favorable. Formerly the relation of the laborer to his employer was generally that of *peonage*. This condition usually arose out of some trifling debt which the debtor contracted to discharge by his labor at a given sum per month. The moment a contract of this kind was made, the relation between the parties became that of master and slave until the debt was extinguished. But, practically, ignorance and heedlessness on the one hand, and craft, greed, and superior intelligence on the other, resulted in conditions which rendered the payment of the debt impossible, and a life-long servitude was the result. Peons, as these bondmen were called, could be transferred from one master to another by the person desiring the services, paying to the master the amount of the indebtedness. This could not be done, however, without the consent of the peon, whose nominal part in the transaction was simply to borrow from one party the means of discharging his obligation to the other. The laws of the country were altogether in the interest of the master, and the peon was treated with great rigor. While a murderer could stalk abroad in open daylight unchallenged, the wretch who attempted to flee from the tyranny of his master was hunted like a wild beast. This institution was a relic of the former rule of Mexico, and disgraced the statute books of the territory until the occurrence of emancipation. But the clarion tones of the proclamation of freedom, echoing over the intervening wastes, penetrated even to this secluded spot. There was a desperate struggle to maintain the system on the pretense that it did not imply *involuntary servitude;* but the sophistry of words could not withstand the logic of facts, and peonage sank into the grave with slavery. But ignorance and improvidence go hand in hand, and the laborer will never attain in New Mexico the position of comfort and respectability he holds elsewhere until the afflux of population from without counteracts the elements of priestcraft and superstition, and opens the way for the school-house and the schoolmaster. Then, when agriculture shall be directed by intelligence, and the science of to-day take the place of bygone ages, New Mexico, with her smiling skies and soft, delicious climate, will become the paradise of this continent.

BEARDLESS BARLEY.

Mr. Geo. Cassidy, Reynoldsville, N. Y., asks what is the value of Beardless barley?

Mr. John Crane.—Beardless barley is pretty good for feed, but is valueless for brewer's use.

AGRICULTURAL IMPLEMENTS FROM SYRIA.

Mr. N. Brown exhibited a series of agricultural implements, such as are used in Syria at the present day, consisting of an ox-yoke, goad, plow and thrashing machine, all of the most primitive character, really such as were used 1,900 years ago. The thrashing machine was a flat board with holes, in which were rough rocks. Weight was put on this board, and it was then driven over the grain. They were from the Rev. Mr. Calhoun, missionary at Arbic, Syria. The chairman called on Mr. Diehl to explain them.

Rev. Mr. Diehl said: I have seen 50,000 acres of grain sown, and all of it put in with a plow worse even than the one exhibited. In fact, nine-tenths of the plows there had no iron in them at all. All the plows had only one handle. The ground was not plowed before the grain was sown, but after. The sower sowed the grain on the bare ground, and the plow followed to tear up the ground, and then a large bush was used to harrow it in. Between the sower and the plow were frequently large flocks of birds, entirely undisturbed and seemingly not at all afraid. I noticed, however, that when we strangers appeared, the birds immediately took flight. The goad had two ends, one a chisel to cut roots, the other a prick to urge on the oxen. The thrashing machine sometimes left parts of the rock among the grain, which all went into the food. A lot of American plows were sent out there, and I was commissioned to go to Bagdad to show them how to use them. I told them they must first make collars for their horses, and endeavored to explain what I meant. Next morning they built up around their horses' necks a great wad of straw larger than a pillow. Then I found that they had cut off one handle from each plow, so that it was impossible to guide them. The people there have to be educated, and their horses, too. One thing he found there was a seeder, very much similar to that we use, which had been there hundreds of years. The cultivation of the soil did not deserve that name.

SALEM COUNTY FARMING.

Mr. Horace Greeley.—I have been to Salem to visit that wonderful place where the plants grow on top of the ground, David Pettit's farm. The location is directly on top of a rich bed of marl in some places uncovered by moss; others covered by six inches of soil, and again by two feet. There is not a spot of ground where the marl is not efficacious, and I would judge that just such land was worth at least $200 per acre. With such a bed of marl it is impossible for crops not to grow. I took my rule and measured the depth of the plowing, and it was fully six inches, much deeper than any of the farmers in the neighborhood plow. In my judgment the whole place is well cultivated, and a good system of farming used. The soil is unexceptionable.

Dr. Trimble.—When marl comes to the surface, land is unproductive.

ASPARAGUS.

Mr. D. B. Bruen.—I have seen some inquiries about asparagus. I have a bed that was put out many years ago. Also, one a year ago. I cut the first last Tuesday; it grows so fast that I have to cut twice a day. If I had sold what I have cut off the bed it would have yielded me fifteen dollars. My beds cover a space of eighteen feet by thirty-six. I was talking with a dealer who grows the earliest asparagus in the market, and from what he told me I learned that he plants the same way that I do. I flat my beds and plant four inches deep. They should never be planted in a hill. It is the same way with beans; one of his neighbors planted his in a hill and found they would not grow. The flat culture enables them to get proper moisture. I put my asparagus twelve inches apart and four inches deep, and cover them with a deep coating of barn-yard manure. I know of beds thus prepared that have lasted over 100 years. There is one such I know of planted by my grandfather.

ONION SETS AND HOW TO GROW THEM.

Mr. I. J. Simonson, of New Springville, Staten Island.—There are several varieties of onion sets, and the manner of their culture varies considerably. I will only mention the ordinary kinds; those raised from seed, the potato, the top and shallot onion. These small onions are planted for the reason that they give the onion much earlier than those raised from seed. For the same time the seed is sown the small sets may be planted, and while the seed takes from three to four months to mature, the sets may be used after one month's planting. For the common onion sets, such as the Weathersfield red, White Portugal and Yellow Danvers, the seeds are planted the same as to raise the large onion, with the exception that the seed is sown very thick, and the onions grow so thickly that they cannot grow large; and when the season comes to pull them, that is, after the onions are ripe, they are allowed to lie on the ground to cure. They are then gathered and kept over the winter for spring use. Potato onions are not grown from seed, but are raised from the bulb, multiplying in itself. First you set out the small onion; this grows till it becomes a large onion the first year. You plant the same onion the next year again, and it produces two or three ordinary sized onions, and if pure, some ten or twelve small sets around them. These small sets are again planted for large ones the following year; but those that grow inside should not be planted for seed, for if they are the seed will soon run out. The shallots are grown much the same as the potato onion. The top onions are entirely different from the other varieties as the small onions, or sets, grow on top of the stalk. These sets must be planted the second year to make large onions; and the large onions planted to make sets.

Adjourned.

May 10, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Experiments in Potato Culture.

Mr. Chas. Sears, Highland, N. J., forwarded a tabulated result of certain experiments in potato culture, conducted at the North American Phalanx in 1851 by J. T. French, with seed of three different sizes, some planted whole and others cut in larger and smaller pieces; which experiments proved that the ratio of product to seed "is greatest from the smallest cut seed, as might be inferred would be the case; but deducting the quantity of seed in each case, and the net product per acre is uniformly in favor of planting whole seed, and also as clearly in favor of planting large-sized whole seed, when the cost of seed does not exceed one dollar a bushel, and the crop sells for fifty cents or more; the ratio of product per acre of marketable potatoes from whole seed being relatively as 100, 90, 73, and from smallest cut seed as 62, 44, 54. Taking only the first or largest sized potatoes, the ratio of product per acre from whole seed, is as 160, 73, 67."

Mr. J. W. Prentiss, Pultney, N. Y., gave the result of certain experiments made by himself as follows: "A good many years ago (thirty-five or more), I selected some Merino potatoes and cut one eye each from stem and seed end, and planted them in separate rows and followed this course for several seasons. The third crop from the stem end, the result was one or two potatoes from each eye planted. These were small, below medium, nearly round, losing the red cloud on inside; outside pale flesh color. From seed end, perhaps half dozen in number, about the size of an ounce ball, irregular in shape and deep red inside. My theory was, not gender, but cutting the potato crosswise destroyed it as an institution, and it run out. If cut lengthwise you have all the properties necessary to promote a healthy propagation, while promiscuous cutting weakens the vitality, and of course is more sensitive to the changes of ground and season. I know good potatoes are grown from single eyes; but if stem and seed ends are persistently separated they will degenerate or run out.

GREEN CORN FOR MILK.

Mrs. Peter Peck, Queensbury, N. Y.—For the past dozen years we have planted maize for our milk cows, and also for a horse. They never refuse it. We make the ground very rich; plant in drills, but far enough apart one way to go through and hoe, or even to go through with a small plow, and let it grow large. We frequently have it nine, ten, and eleven feet high. Oftentimes it ears as nicely as when cultivated for eating. We always planted the evergreen sweet. The ears we husk and feed to the hogs for early feed. No matter how large the stalks, they are sweet and brittle. We feed nights only, but feed heavily. We never wilt the stalks, but frequently cut early in the morning, when wet with the dew, and pile it in the barn to keep fresh for night. It makes the sweetest butter and thickest cream of anything we feed.

H. L. Reade.—This statement pleases me. The farmers of this country could increase their butter ten per cent, if they would have an acre, or even half an acre, of sowed corn ready to feed out by the 1st of August. Manure the patch generously.

MIGRATION TO THE SOUTH.

Mr. J. B. Lyman, read a paper on the present condition and attractions of the south. Passing through Virginia, he lingered a week in the Piedmont counties and in the highlands of North Carolina; went thence to the valley of East Tennessee, down it to Chattanooga, passed a few hours at Corinth, arrived at New Orleans by way of Mobile; ran up into Mississippi for a day, and returned to New York by way of Cuba. Has the time come when the full tide of migration, now setting so strongly to the west, should be diverted to the States recently at war? In a general way I answer, that on an average five years' industry will be likely to give a man a better and more valuable farm at the west than at the south. The average of western land is much better than the average of southern land; and a quarter section in Kansas or Colorado is much more likely to double in value than a cotton farm of 160 acres. While this is true, there are chances and openings and specialties at the south which promise better than the average grain and grass farm of the prairies. I will mention a few of these.

First. From five dollars to fifteen dollars an acre will give title to a tract of good red clay upland in the Piedmont counties of Virginia and North Carolina. This belt extending sixty miles eastward from the peaks of the Blue Ridge, was made for an unequaled farming country. If the labor system had been just and the farm practices sound, these lands would have been equal in productiveness and in value to the best grain farms of eastern Pennsylvania and western New York. If you would know how *not* to do, go and see how these land-owners have done. They illustrate every wrong way and every mistaken usage in agriculture; they have taken everything off and given nothing back; they have borrowed, but never paid; they have overtaxed the flat lands, and allowed the washes to deepen into gullies on the slopes; they have given over to sedge grass what should have been blooming in clover; and little pines are growing where should be orchards of apple, and pear, and plum, and peach. But I do not call the red lands of the south exhausted. Scratching a surface with a little plow pulled by a weak horse, or a stiff and bony mule, will cause three inches of the surface to grow poor and to wash away. That is all. Lime and clover seed and ten inch plowing, with circle ditches to stop the washing, and the pine bushes cut close and thrown into the gullies, will raise all those lands to a producing power of twenty-five bushels wheat and fifty of shelled corn. With proper management, five years time will do it, and then an acre of it will be as well worth sixty dollars as any prairie farm.

Second. In the higher parts of the south are millions of acres quite well adapted to grass; but they are, as a rule, remote and wild and steep. The climate, however, is the purest, the most wholesome and balmy on the continent, and many, who will in a few years die of throat and lung affections in the north, would come to a green old age on those sunny mountain slopes and elevated plains. Those who for sanitary reasons remove thither will find most profit in wool, in honey and dried and canned peaches, in winter apples, in manufactures which call for ash, locust and black walnut timber, and in extracting tanners' ooze from oak bark

Third. The cotton lands I regard as the least attractive to northern settlers, especially farmers with a few hundred or a few thousand dollars. The freed negroes have the year past made 3,000,000 bales. The prospect is that 3,500,000 will be made in 1870. If so, much of it will sell for less than twenty cents, some for less than fifteen cents per pound. The true interest of the cotton belt is not in growing more but less cotton and more food. Beside, cotton calls for a monotonous and dreary round of treadmill toil from January to January again; and a white man had better be sowing wheat, or making hay, or milking cows, or hewing railroad ties. Work of that sort has not been found to choke out the intellect and dwarf the man. But to toil side by side with the African, under that scorching sun, on the banks of those muddy streams, exchanging the plow-handles for the cotton-bag, and the cotton-bag for the plow again, I do not recommend to any man who can preëmpt a Kansas homestead, or see the sun from his cabin-door sink behind the goldribbed peaks of Colorado. The tropical parts of the south I regard as most inviting to all who, from fancy or declining health, prefer a climate without frosts. I hear of a pine-apple garden in Florida, one acre in extent, that has brought its owner $5,000 this year. In Louisiana a settler can have from forty acres planted in figs, in oranges, in broom corn, sugar-cane, and yams, at large profit, with more moderate and varied labor than would be necessary in farming any one hundred acres in the north. In the southern part of Florida one can go beyond the line of frost, and be sure of tropical crops that never fail. If I were willing to forego the invigoration of cold winds and the tonics of ice and snow I would go well to the southward and give up apples to enjoy figs all summer, and forego sleigh rides to pick oranges from the trees all winter. In conclusion, then, I recommend to all who are willing or compelled to give up the dash and thrift of a bracing climate for air that is balmy, and winters that are short, to seek the highlands of the south, to go over the western North Carolina road to East Tennessee and northern Georgia.

There is a region 300 miles wide and 400 long where the best lands are held at fifty dollars, and the steepest at fifty cents, and where there are no diseases but such as are imported or inherited, or bred by uncleanness and low living.

Fourth. As to the manner in which northern settlers are received at the south, I will say this: Robert E. Lee is the living hero, and Stonewall Jackson the glorious martyr of the south. No northern settler, no matter what his industry, his piety, his courage or his cultivation, may hope to shine beside the men who fought under the eye of these martial demigods. But there are few portions of the southland where a Yankee who is not a politician is not entirely safe in his person and his property. Socially the northern settler will be most at home in those parts where slavery was of little profit. But whereever enforced labor was highly lucrative, there he will be counted among those who labored to upset the prosperity of the south.

Those who think the steps of American history have been during the past decade all grand and safe advances, who admire Grant, think well of Butler, respect the memory of Stanton, and look upon Lincoln as a great martyr in a great cause, and who wish to be open and free in avowing such views, will not meet a cordial reception at the hands of the southerners. They will sell him land at moderate figures, but he should go with others from the north, enough to make a hamlet or a clan, so he can be sure of a school-house, with a schoolmarm in it; a church, with regular service; roads over which a horse can trot; of bridges in place of fords; and painted cottages in room of log huts. While I have stated thus candidly the present state of southern feeling, I will say that the tendency is all in the right direction. The evils are shrinking, and the good prospering. Those who hate the Yankee most admit that he can do more for their weal than the southron. Some are ready to admit that as from the north came the conqueror with well-shaped arms, so from the north must come the peaceful settler, who, with plow well molded, with grass seed and Short-horns, with lathe and forge, and boiler and tank, and vat and pick and adze, shall truly and permanently reconstruct the south. I will say, also, that the veneration for times that are gone, and the soldiers that are dead, is mainly displayed by those who slept on feather beds through the war. I found no men more peaceful, or industrious, or civil, or glad to see northern land-buyers than the men who stood up four years in a square fight for a separate government. By the time the narrow head-boards are rotted away, and the earthworks have melted to low grassy ridges, the bitterness will have died out. Their cotton will be twisted by spindles made in the north, but driven by southern waters; the companies that own the roads and run the boats will be made up of capitalists from both sections; our clover will grow there, our practices will be adopted, our seed-grain sought for, our thrift emulated. Whatever defects the southerner may have, he is not uncandid, and he will be more and more rejoiced to see his Carolinas shining like the Empire State, and his Virginia coming up by an infusion of northern thrift and skill from the ashes in which she sits to her old position of leadership. The south thinks she needs northern money for cotton-mills and iron forges. That may be; but what she most needs, and in her heart must welcome, is the progressive northern farmer; the man who leaves his surface every year better than he found it; who borrows from the earth but never robs her; who plants for his heirs, and earns money before he spends it; who honors labor six days in the week, and on the seventh honors God.

DETECTING ADULTERATIONS IN GROUND BONE.

Mr. J. C. Thompson, of Staten Island, by invitation took the platform and explained a method of detecting adulterations, such as sand and similar substances in bone-dust, etc. It consists essentially in subjecting the ground bone to the action of dilute sulphuric acid as follows: A portion of the bone-meal or flour is placed in a cup or tumbler, and three or four times its volume of water is poured upon it. To this is added an equal quantity of common sulphuric acid. The union of the water with the acid produces heat. (This Mr. Thompson illustrated by cooking an egg in the liquid.) The heat enables the liquid to dissolve much of the bone and hold the remainder in fine particles in suspension, while the sand, if any exists in the material, sinks to the bottom, and may be found by pouring off the liquid. (Mr. Thompson illustrated this by a few simple experiments.)

Mr. John B. Russell, at the request of the chair, examined the results, and stated that they showed the absence of any foreign material, as above mentioned. The bone flour thus tested was stated, during subsequent proceedings, to have come from the manufactory of Lister Brothers, of Newark.

Mr. Thompson also explained the method adopted in this country for making the sulphuric acid used in the manufacture of superphosphate from iron pyrites in place of the crude sulphur used abroad.

Mr. H. L. Reade suggested that the chemist speak of the practical bearings of the experiment upon manures.

Professor James A. Whitney.—We must take into consideration the nature of bones. They contain about one-half their weight of phosphate of lime and a little less than forty per cent of organic matter, a portion of which is capable, by decomposition, of yielding ammonia. The rest is made up of small quantities of other substances, among which is a trace of lime, probably existing as a carbonate. If we put the bones in a pit, for example (one lined with clay), and pour water upon them, and, after adding oil of vitriol, cover them over, we shall have these results. The heat given out by the combination of the water with the vitriol will, of course, raise the temperature of the mass, and possibly assist the production of ammonia, from the organic matter, but the great advantage comes from the fact that the oil of vitriol drives out the phosphoric acid from a part of the phosphate, producing sulphate of lime, while the liberated phosphoric acid unites with the rest of the phosphate to form superphosphate. In this latter the phosphoric acid is soluble in water, which accounts for the rapidity with which it acts upon crops. If there is any free ammonia from the bones, the sulphuric acid will unite with it to constitute sulphate of ammonia, a condition in which ammonia is very available for manure. Sulphate of ammonia as a commercial article has been extensively used as a fertilizer, with good results, but for some reason does not show as much advantage as an equal quantity of ammonia in natural fertilizers, such as barn-yard manure and guano. It is quite frequently mixed with commercial fertilizers to supply any deficiency in the certified per centage of ammonia in the original product.

FLOWER AND FRUIT CULTURE.

Mrs. M. F. Gillpatrick, of Morristown, Ind., has trouble in raising peonies, in consequence of little black ants, thousands of which cover the plants, and prevent blossoming. Pray what is sure cure?

Mr. A. S. Fuller.—Sprinkle, when wet, with snuff or dry lime.

Mr. S. J. Gregory, of New Hartford, Conn., has been plagued not a little with the onion maggot; still he dislikes to abandon the odorous esculent. What shall he do?

Mr. A. S. Fuller.—Give the soil a light dressing of salt; a liberal quantity will not injure the crop. Lime will sometimes answer the same purpose.

Mr. T. J. Harvey, La Fayette, N. J., has a peculiar kind of white blackberry, transparent, of medium size, very sweet, the canes of dark green. What shall he call it?

Mr. A. S. Fuller.—The variety is already known by several names, but the more common is Chrystal White.

Mr. G. W. Allen, East Bridgewater, Mass., planted pear trees six years ago; none have grown much and some are dying. Upon examination no sign of borer is perceived. What can the matter be?

Mr. A. S. Fuller.—Victims of starvation; remedy, liberal application of manure.

Mr. W. Hall, Flemington, N. J., has twenty-five acres of warm clay loan, having sunny exposure, not too wet, and seldom suffering from drouth in the dryest seasons; fifty miles from New York, one and a half miles from railway station. What shall he grow for market crop? How about gooseberries, currants and asparagus?

Mr. A. S. Fuller.—Gooseberries or currants would do very well, and if properly cared for would pay more than $100 per acre. There is ready demand for all that are offered. Asparagus might thrive, but if the soil is cold this crop would come on too late to bring best prices.

Mr. David Sackreder, Napoli, N. Y., set 100 apple trees, ten years ago, in dry, rich soil, from which no crop had previously been taken.

Trees grew thriftily and bore fruit; are from five to seven inches through. In examining them this spring, I find that from the ground up, four to ten inches, the bark is loose; bark is green on outside, but black and dead next the wood. Wood also black, and apparently dead. Now, what is the cause of this, and what the cure? Some tell me it is because the trees were grafted in the root; others, that it is the frost. Will banking earth round the trees, so as to cover this dead place, save them? Many of my neighbors' orchards are in the same fix.

Mr. A. S. Fuller.—These trees are certainly in a bad way. They are injured by the frost, which has burst the bark from the wood. In a mild, wet winter, trees are often thus affected. On a very rich soil, apple trees are more likely to be harmed when they grew rapidly late in the fall. I would recommend the banking up, as proposed, this spring, and then remove the dirt in July or August. Perhaps wrapping these parts of the trees with course matting will answer the same purpose.

THE SAVING QUALITIES OF SOOT.

Mr. John Hague, Clinton, Iowa, wrote that in England soot is gathered by professional "sweeps," and sold at a high price to farmers and gardeners, many of whose crops would perish were it not for a liberal use of it, especially roots. It is an old and well known remedy for the turnip fly, and hundreds of bushels of it are used, being thrown or sown broadcast on young turnips on dewy mornings, and many a crop of onions and carrots has been saved by sowing soot on the young plants when infested with insects; and if a liberal sowing of it be made, say three times between a carrot or onion, being an inch, grown from the seed and its final growth, it will pay the man or woman that does it. There is no danger of its hurting the plants after they have grown an inch or two.

CURE FOR GAPES IN CHICKENS.

Mr. W. R. Bunnell, Bridgeport, Conn.—It is at hand in every house, and has been used by me for thirty years, but I have not seen it in the papers. Soft soap is the magic word, and it is so effectual that not a chicken in the country need be lost by this devastating disease. Mix into a table spoonful all the meat it will hold for feeding, and give it to a brood of ten or twelve; all that die from taking it, or all that die from the gapes after taking it, I will pay for at any price. For this I hope to be remembered at future thanksgivings.

To get rid of Boulders.

Mr. W. Forrest, Middleport, N. Y.—After thirty years' experience with large field stones, which are beyond the capacity of a team to draw, he is convinced that the best and cheapest way to dispose of them is to bury them. "Dig a hole just at the side and partly under, and when you are sure you are deep enough, just take a lever and give the stone a start, and you have only to throw in the earth over the stone and you have a smooth job. Care should be taken to dig the hole so deep that the top of the stone will be eighteen or twenty inches below the surface when the earth is replaced.

Bloody and Clotty Milk.

Mr. T. A. Croy, Ontario, Iowa.—I have noticed several explanations, but none have been satisfactory to my mind. My own ideas are: First, it is frequently the case that cows have to forage in the timber, and often come in contact with hard substances, such as brush and logs, and thus injure the udder and cause bloody milk. Secondly, in our prairie States, where the country is sparsely settled, cattle forage at large on the prairies, and have to be brought a distance of from one to three miles, and this duty is frequently performed by some of the young members of the family who are fond of riding on horseback, and often the milch cows are brought up, on a full run for a mile or more, and at the same time the udder is filled with milk, and the legs beating against the udder, first on one side, then on the other. This severe running is what frequently produces bloody milk; and sometimes the dog is set upon the cows when bringing them from the pasture, and sometimes when in the barn-yard; this will also produce the same result. At intervals cows will give clotty milk. This is caused from the same treatment which we have referred to; and when cows become overheated and cool off, the milk will become coagulated in some part of the udder. I would recommend all persons who wish to have good, healthful milk never to suffer their cows to be driven faster than a walk.

Colossal Asparagus.

Mr. S. B. Conover, Washington Market, N. Y., made a fine display of this appetizing succulent, the various bunches of which were quite dissimilar in appearance. He thought that a glance must have the effect of convincing even the most incredulous of observers that there are different sorts of asparagus, and that Professor Mapes was not so far wrong after all in claiming twenty-three. Among the sorts showr were "Conover's Colossal," which quite dwarfed the other bunches, and a new unnamed variety of a beautiful green color. This latter, Mr. Conover explained was grown in the bed devoted to Colossal, a fact which he thought indicated that the seed of Colossal, as secured in Holland, must have been mixed.

DRAINING AND DRAIN TILE.

Mr. J. Funck, Danville, Iowa.—I have eighty acres of flat prairie that needs draining badly, and we have but one man in the neighborhood that understands laying tile, and he finds plenty of work at three dollars a day. The wet season has put almost every one in the notion of draining. What should tile be worth where wood can be had at two dollars per cord, and common labor is worth one dollar per day, with clay and timber convenient? Our tile-makers here charge twenty-five dollars per 1,000 for one and a half inch tile, and more in proportion to size. This we farmers consider a little to steep in a country where wood and clay are plenty and cheap. Can you give us a remedy?

Mr. John Johnston, Geneva, N. Y.—The only way for these farmers who are charged such high prices for tile is to erect tile works, procure a machine, and manufacture their own, as several farmers have already done who have applied to me for advice. A number of farmers joining can get a machine and have their tiles for eight dollars per thousand for which they are charged twenty-five dollars. In laying tile, any common laborer can perform that part of the work.

HOW TO GRAFT GRAPES.

Mr. David S. Wagener, Pultney, Steuben county, N. Y., who has originated three new and distinct methods of preparing stalks for grafting, was called upon to describe the method by which success was most certain in grafting grape-vines. This subject called out a great deal of interest, from the fact that the attention of the Club has several times been called to the thousands of acres of vineyard in this State, which, though composed of healthy, vigorous vines, are of little value, owing to their being planted with late or unprofitable varieties. Mr. Wagener exhibited the instrument used in preparing the stalk of the vine to receive the graft. It consisted of a common stiff-back saw, with keen steel blades attached to the ends of the saw, and set at an angle inclining to the saw's edge.

Having used the saw to cut off the vine at such place as is considered desirable to insert the graft, the operator, instead of splitting the stalk uses the same saw to cut a kerf as deep as the scion should be inserted, and either by drawing the saw toward himself or pushing it through the kerf from him, the steel blades at either end of the saw cut the kerf to a true level ready to receive the scion. By this process a quick workman can graft several hundred vines per day, and by having the scions and stalks cut evenly and true as is done by this process. Mr. Wagener assured the Club he has always succeeded in grafting grape-vines with as little per centage of loss as on pear or apple trees. He recommends grafting the vines after they have started in the spring, between the 20th May and June 5th.

Adjourned.

May 17, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

INDIAN HEMP.

Mr. J. B. Morton, Plainville, N. Y., forwarded specimens of the fiber commonly known by the above title, consisting of raw material, and also of the manufactured article. He has often wondered if it might not be put to some practical use; thinks it superior in fineness and strength; fails to see why it should not be cultivated and become a staple of commerce, as it is easily grown upon waste places now overrun with rushes. "But the question is, 'Will it pay?' If one knew *that*, it might be determined whether it would be worth while to invade the home of the bull-frog and plant therein the fragrant *epocynum cannabium*."

Mr. A. S. Fuller advised him to grow a few tons as an experiment. Though often referred to, the material has never yet been practically tested on any considerable scale. Until such test is made by some person willing to cast bread upon the waters, of course we can only speculate as to its possible value or importance.

ROCHESTER BERRY BASKETS.

H. N. Peck & Co., Rochester, N. Y., brought a new patent, which they asked the club to pronounce upon. They can sell this basket at ten dollars per thousand less than the Beecher, which is no better.

Mr. A. S. Fuller said it looked well, and would probably prove first-rate. However, there is little use in introducing new baskets, unless they possess some very special advantage. Those we already have, prominent among which is the Beecher, are all that can be desired, unless the new candidate is afforded at a price considerably reduced.

The chairman thought that the competition which would follow the introduction of new baskets must necessarily have a tendency to bring about this desired diminution of cost.

TRIBUTE TO THE MEMORY OF SETH BOYDEN.

Mr. D. B. Bruen, who was requested some weeks since to prepare a memoir of Seth Boyden, read a very well written and interesting paper, in which he spoke appreciatively of his deceased neighbor, who, though little known in his life, obscure and almost a hermit in relation to his associations with mankind, had ingenuity and inventive skill, which were exercised in such a way as to stamp its impress in every household, every stationary and locomotive engine, and to bring to others such fortunes as have not resulted from any similar inventions of the present age. And yet, after being so great a benefactor of the race, his entire life was spent in incessant labor made necessary for the support of his family, and he died at the age of eighty-two, with many projects undeveloped. Early in his youth he was occupied in the culture of the soil, and occasionally in a smith's shop in repairing farm implements. Afterward he went to Newark, N. J., with a machine of his own for splitting leather, and in that town his subsequent achievements were wrought out and developed. Personally he was of "a gentle, quiet, lovely and contented nature." Sympathy has been expressed for his poverty. He never needed pity. His wants were strange and simple, and were always supplied without incurring any sense of obligation to others. A more independent life never was. He had home, comfort and his own way. Best loved by those nearest him; modest to a fault; careless in money matters, yet so frugal as to be always out of debt; reverenced by all men of sense, and honored for his achievements, his heavy, bended, plainly clad form passed almost unnoticed in the streets; and the rough, rugged face, marked with continual thought, had not a line of care upon it. It was a singular face, homely and irregular yet pleasant, the eyes meditative and sometimes introverted as if he was reading from the scroll of his brain; never sad or sour, to him God so tempered the winds that sorrow smote him heavily. He was only half conscious of himself. He knew that he had painfully toiled to results which a little early education would have placed in his immediate grasp, but he never comprehended the fact that he himself was a genius, a benefactor to his race. His was a strong and unselfish life. Let us rejoice that it was one of unceasing toil, knowing no luxuries, and poorly rewarded, that his sunny soul and the love of his family were all the light and cheer it needed. He looked ever to the future, cared not for the present, and was careless as to the past; with him ends a noble life.

Mr. Wm. Lawton spoke of the deceased, and more especially of his achievements in the propagation of strawberries. Among his earliest successful ventures in this line was the "Agriculturist," a variety which Mr. Lawton regards as very valuable, and which he would retain in preference to four-fifths of the newer candidates.

Dr. Isaac P. Trimble alluded at length to this part of Mr. Boyden's life-work. When the Agriculturist was exhibited in New York, it created a decided sensation among horticulturists, and of course it gained the first honor without question. Mr. Judd bought all the plants, except one, and great numbers were brought out and distributed as premiums during the subsequent season. Mr. Boyden's next berry was the Green Prolific. At that time this was his favorite. In several respects he considered it superior to the Agriculturist, and time has proved that he was correct. Amongst many others came Boyden No. 20, but these did not satisfy him. At the time the Peabody Seedling, a Georgia berry, made such a sensation, Boyden got some of the plants, but like others who tried it, gave it up. Soon after this, he asked me if I had any plants of this berry. I replied that I still kept a few, and told him where he could find them in the garden. "But," says I, "what do you want with a berry so inferior, especially in our latitude?" He replied, "it has one good quality I wish to incorporate in a new berry." This was in the spring. In July I visited him one very hot day. He was in his garden, barefooted and bareheaded, planting strawberry seeds. Adam in the Garden of Eden before he had been bothered with Mother Eve, could scarcely have looked more innocent or have been more innocently employed. From one of those seeds came that greatest of strawberries, Boyden No. 30. Mr. Boyden was then an old man, and did not care to wait a whole year for the frosts of winter to prepare these seeds to germinate, and he made for them an artificial winter by subjecting them to a freezing mixture. The earth in which they were planted had been carefully sifted and then gently sprinkled with water. Many people wondering how Mr. Boyden succeeded in propagating so many strawberries of such superior merit. Those strawberries were the results of design. Others take the seeds of good fruits and hope to improve upon them, and sometimes they do, but they are accidents. The seeds from our modern cultivated strawberries seldom produce fruit precisely like the parent, though partaking more or less of its qualities. Some will strikingly resemble other well-known varieties, and we judge that bees have been instrumental in fertilizing the flowers from which those berries grew. Seth Boyden was a botanist, and believed in science. He fertilized strawberry blossoms with his own hands, leaving nothing to the wayward impulses of insects or winds. Some doubt this, but I have been told by Governor Ward, that he and the late Nicholas Longworth once found him so engaged. And to guard against insects frustrating his wishes, he had millinet carefully spread around such plants as were intended to propagate from. Jacob, the son of Isaac, who was the son of Abraham, bred cattle and sheep and goats to order. This was under a dispensation long past. Modern stock-breeders improve by crossing. A too prominent defect in one parent is counteracted by a corresponding deficiency in the other, the two being naturalized into perfection. This crossing has become a science. Seth Boyden practiced crossing in creating strawberries; and some of them had a numerous parantage. The defects of one were counteracted by the good qualities of another. A long experience, summing up in that rare combination of merit, No. 30. The size of the fruit was the result of feeding the plants with such fertilizers as chemical analysis and his own experience had proved the best. While Mr. Boyden did not believe in extra deep tillage, he did believe in that careful, constant stirring of the surface so necessary for growing plants, especially in dry weather. It has been told far and wide that Mr. Boyden believed that he could make strawberries as large as pine apples. I never believed he said so. He was too modest a man to boast of anything. But to set the matter at rest I asked him the question. "I never said so," was his prompt reply. "I believe I could make still greater improvements if I could live long enough, but that idea is absurd." Boyden was a great lover of nature, and wonderfully fond of pets, a very Cowper in this respect. In his last illness, when his appetite failed, it was proposed to shoot him a bird—"what bird," said he—"A robin; they have come." He forbade it absolutely. Last summer I saw him feeding some young English sparrows. He was anxious to find out how far they would be useful as feeders upon insects. Some years ago he took great pains in making a fish-pond. But no other use was made of the fish than as pets. He taught them to take food from his hand. He had a favorite cow of his own raising. Last fall he took her to the State fair and kept her there three days, attending her all the time himself, actually lodging upon some hay in a part of the same stall every night, so anxious was he that nothing should happen to her. He was awarded a premium of twenty dollars for the best cow of her class, but he never called for the money, merely replying that the society might as well have it. That money has been collected since his death, and has been used toward paying his funeral expenses. The last time I saw Seth Boyden he was patiently at work compounding metals. Not like the ancient alchemists, attempting to transmute the baser metals into gold, but so uniting different ones as to make a substitute for gold in the manufacture of knives, forks, spoons, watch-cases, etc., so that they should be as bright, as solid, and as durable as the pure gold itself. He was at work in an old green-house, the glass roof affording a perfect light. His little furnaces, blow-pipes, and other apparatus seemed wonderfully inadequate for such purpose. His experiments while I was there all failed. The different ingredients would not melt together, or would not weld, or could not be hammered, or were too hard or too soft, or defective in color. But I have heard it said that Seth Boyden mastered everything he ever undertook. His industry was untiring; and what patience, what perseverance! I have been told that he even worked out that problem. The alloy he sought after was actually compounded, but the secret is buried with him. Here is a fork made in the progress of this investigation. Mechanically it is not perfect, but he was then nearly eighty-two years old. After hearing Mr. Bruen's most interesting account, and knowing as I do of so much more that Seth Boyden contributed to the good of mankind, I am reminded of the language of Dr. Johnson on a well-known occasion. Thraile, the great London brewer, chose Dr. Johnson as one of the executors of his will. The property was to be sold at public sale, and Johnson made proclamation of the terms. "Gentlemen" said he, "we propose not only to sell you these mighty buildings, these enormous vats, and this wonderful machinery, but we will put into your possession the means of accumulating wealth beyond the dreams of avarice." That was the language of a poet. But where is the poet whose imagination can comprehend the amount of benefits the genius of Seth Boyden has conferred upon his fellow-beings.

GRAPES IN CAYUGA VALLEY.

S. J. Parker, M. D., Ithaca, N. Y.—We have had no grape in the Cayuga Valley, for winter eating, that equals Roger's No. 1. All of Roger's grapes have a little of the harshness of the parent, Mammoth. This is lost in the No. 1, by keeping till December 15th or January 1st. Of all his hybrids none bore more or better fruit than this one.

The excellence of it is that this number can be picked green, that is, with no more color than a foreign green Malaga, and ripen in boxes, and be eaten with as much pleasure as the foreign grape. So well is this established that some of the professors of Cornell University and strangers as well as our citizens, are willing to pay twenty-five or thirty cents for No. 1 when Concords are ten cents per pound. I am a decided friend of the Eumelan, and also of the Iona. Both have excellencies well worth considering. The past season was one of the severest we ever had. It would have been better had our vines been barren than to have had so many lost for want of ripening. In many places we literally trod the ground, late in the fall, strewn with unripe grapes; while grapes from Ohio and elsewhere were thrown on us at cost, less than that of the boxes and freight. Yet I hope our grape growers will not be discouraged. Years of reverse must now and then come. The best sample of Concords I ever eat was the early ones sent me by Edward S. Hipple, of Maryland. If our southern friends continue to raise such delicious grapes, it will lessen the value of our later ones. Martha, last fall, far exceeded our expectations. It is a fine grape. The Sugar grape of our Shaker friends of Mount Lebanon, I am very sorry to say, is in my opinion not worthy of attention in any place where any other grape will grow. It is worse in foxiness than the Rachel of the Agricultural Department, and not earlier than that. The Mary Ann, in Mr. Cornell's vineyard, six miles down the Cayuga lake, last fall was very early in the market, sold well, and may be considered as proven a valuable early vineyard grape. Such are some of the many facts of the last season in grapes.

CURES FOR CLUB-FOOT IN CABBAGES.

Mr. E. Carpenter, of Wadesburg, Mo.—Mix a handful of ashes with the ground or hill in which each plant is placed, and if there is a long tap-root it should be removed. In 1831 my father's garden was heavily manured with slaughter-house manure to which hogs had access. Consequence, club-foot. An old neighbor furnished other plants with above instructions; result, good cabbage. I have tested the plan every season since, and never knew a failure.

Mr. W. Johnson, Orwell, Ohio, gave the same prescription, with a difference. After the plants have been set out a week or ten days, lay the roots bare with a garden trowel, and put about a tea-spoonful unleached ashes on them, and replace the dirt.

Mr. John Hague, Clinton, Iowa.—If I were afflicted with club-foot in my cabbage patch, I would sweep out all the stove-pipes and chimneys I could get at, and save every grain of soot I could, to spread on the ground some still day just before sowing the seed, then I would work it into the soil about two inches or so in depth; for if the soot came in contact with the seed it would very likely kill it just as it was germinating; but if worked in as I have stated, there will be but little danger. When transplanting cabbages from the seed bed, I have for such a number of years (I don't know how many) made it a point to get equal parts of soot and soil or common clay, and mix the two together in water to the consistency of thin paint. In this mixture I dip the roots right up the stem to the leaves, and even on the leaves a little before shifting the plants where they have to grow for heads, and I have invariably had success in growing good cabbage, cauliflowers, and others of the same family without so much as one plant in a thousand being troubled with club-foot. Last season, for various reasons, I neglected this precaution, and my cabbage crop was a failure. In the past score of years I have raised some millions of cabbage plants, often as many as half a million in a single year, and I don't believe I have had a thousand, all told, of club-footed ones, even on places where the wireworm has been in plenty.

Words of a Western Farmer.

Dr. Bland, upon invitation of the chairman, spoke briefly, thanking the Club for the unexpected honor conferred. He said he had known the Club long through the medium of the reports, and that, though in many respects it failed to supply the necessities of the western farmer, it was much esteemed in the wide section of our common country which he represented. Alluding to himself, he remarked that he had always beed interested in rural pursuits, and that he intended to devote the remainder of his life to bettering the condition of the agricultural community. He closed by inviting the members of the Club to "come west," and promised that they should find hospitality and appreciative welcome.

Crows.

Mr. T. Bennett, Chester county, Penn.—The legislature of Pennsylvania has put a penalty on the destruction of birds or their nests, and though the intention is good the effect is a nullity. It is a well-known fact that the crow and crow-blackbird are the chief destroyers of insectivorous birds, devouring not only the eggs, but the young birds in every nest they can find, and it is a certainty that they do find a large portion of them. If the legislature had offered a bounty for the destruction of these pests, including hawks and owls, they would have done an act worth much to the community. There are many silly people who say these birds should not be killed, they were created for a good purpose. The wolf, weasel and rat were also for some use in creation, but it is generally thought that they can be dispensed with. To say nothing about the killing of insectivorous birds, the corn annually destroyed in Pennsylvania by the crow and crow-black-bird, would pay a bounty to soon exterminate them, if it was not for the shyness of these thieves and pests. We put corn around the field for the birds at the time the crop is coming up. It is at the time of the ripening they pick open the husk, eat part of the ear and let the rest of it spoil. We annually have bushels of the largest ears spoiled in this way.

Mr. Lewis A. Thomas, Dubuque, Iowa.—In the proceedings of the Club some time since, one gentleman is reported to have said "that, *with the exception of crows*, he was very much in favor of protecting the birds by law." I desire to inquire why he makes that exception? Of what crimes and misdemeanors is the crow guilty, that he should be excluded from the provisions of a law protecting other birds? I think he, in common with a great many other people, entirely mistakes the character and habits of the crow. In the spring plowing time, did he ever notice the great number of crows engaged among the fresh turned furrows, picking up something; and when disturbed in one part of the field flying off to another? What are they doing there? I once killed a crow thus engaged, just to find out what he was doing, and his craw was full of cutworms. The young crow is a most voracious eater. He will gulp down a good sized lizard, frog or mouse, or any number of grubs, cutworms and caterpillars, and instantly clamor for more. Thus he will continue to clamor and eat and eat and clamor all the day long, and during the entire period of his young crowhood. Even in the night he will still clamor for food, after having been gorged all the day. It is safe to estimate that the two parent birds will each make a trip for food once in four minutes; their joint arrivals being once in two minutes, each bearing, upon an average, a half dozen of these insects and vermin, which will make 180 per hour, or 2,888 in sixteen hours, about the length of time the crow works. I have seen a pair of crows destroy a caterpillar's nest, of at least a thousand grubs, in less than an hour. The crow and the blackbird are almost the only birds that will destroy the common caterpillar, that pest of the groves and the orchards; and yet they are more universally hated and execrated than all other birds, the hawk not excepted. I could never understand the reason for this universal hatred.

Steaming Hay.

Mr. C. F. Peck, Elsworth, Conn.—Will steaming good hay increase the quantity of milk?

Mr. J. B. Lyman.—This question was much handled in the Farmers' Club the past winter. I heard a number of able discussions, and have asked many larger dairymen the results of their experience. Good sweet, early-cut upland meadow hay is as near being perfect cow food as anything you can get, and steaming makes it no better. But in feeding all coarse, late-cut, dead-ripe grasses, and for straw and stalks, the testimony of hundreds of farmers is all one way, that it makes two tons go as far as three unsteamed.

The Yankee Hay Fork.

Mr. E. P. Gleason, No. 135 Nassau street, New York, exhibited the Yankee hay fork, which was referred to a committee to report on its merits.

Adjourned

May 24, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

The Culture of Locust Trees.

Mr. D. Turner, Connellsville, Pa.—In many rock-bound neighborhoods, this variety of tree can be grown with great profit upon land almost worthless for other purposes. He has found, in fact, that gravelly or stony knolls and hillsides are most suitable, and that locusts do best in a thick growth of their own or of other timber, because this has a tendency to make length. As to lack of hardiness, there is no fear of that, and when the locust is in thick groves the borer does not so infest it.

Mr. Wm. Lawton said that grass would grow under locust trees when there seemed to be hardly soil enough to grow anything. Yet the grass was always the greenest and most beautiful under the shade of the locust tree.

Cooking Food for Cattle.

Mr. W. H. Wilmot, Illinois, had some experience in the matter of cooking food for cattle. After a complimentary allusion to some prior statements of Mr. F. D. Curtis, he proceeded to say that one of his neighbors had settled the question satisfactorily in favor of cooked food. He has a mill that cost sixty-eight dollars, run by two horses, that will shell and grind into fine meal fifteen bushels of corn per hour. He has also an apparatus (cost $120) that will cook this fifteen bushels of meal thoroughly in one hour and a half, and one quarter of the cobs from the corn will furnish the heat; or he can cook with a bushel of cobs a barrel of potatoes in twenty minutes. The question of fuel, then, in the case is only nominal. Here, then, is a saving of four bushels of corn by two and a half hours of labor, the cost of which will not be over fifty cents at most. This steamer can be put up near the house, and used for washing, rendering lard, scalding hogs, etc.

Mr. H. L. Reade thought it an undisputed fact, that a saving of full twenty per cent was effected by cooking food. All means to lessen labor were valuable.

Sowed Corn for Soiling.

Mr. John H. Curtis, Cherry Creek, N. Y., in a very lengthy communication, spoke in high praise of the remarks made on this subject at a previous session by Mr. Frank D. Curtis, and he gave some confirmatory items from his own experience. "Two years since I sowed one acre. The pasture began to dry up, and we never had such a drouth in this section, and about this time I began to feed the corn to my cows. It continued very dry until winter, so much so that there was scarcely a green thing to be found in the pastures. My neighbors' cows, that had no sowed corn to eat, were almost starving, and nearly dried up, while mine gave a good mess of milk and improved in flesh. There were several men of good judgment who estimated that one acre of sowed corn as being worth seventy-five dollars; and I am confident it was worth all of that to me. I would, therefore, say let every dairyman, if the prospects are fair for a good season and plenty of feed, sow a good field of corn, it will not come amiss, and if the prospects are that we are likely to get a very dry season, sow double the quantity, at least one acre to every ten cows; for it is certainly the dairymen's antidote for short pastures, short crops of hay, and short pockets. The ground should be well manured if it is not already very rich. I generally sow as early as the 1st of June. If it is a dry season it is much better to sow early, so that the corn will get well started and shade the ground, and it will then stand quite a hard drouth. I always sow the large western corn, as it will yield nearly double the quantity of feed that the smaller varieties will. If sowed broadcast, it requires from three to four bushels per acre; and, if sowed with a drill, about half as much. I prefer sowing with a drill, for the reason that it takes so much less seed. A bushel and a half of seed will sow an acre in drills from twelve to fifteen inches apart, and three inches in the rows. It is not much more than half the work to cut it than when sowed broadcast. There is no better crop to seed down with than sowed corn. Some of the best meadows that I have got were seeded down with it; but perhaps it is not to be recommended, as it might interfere with the growth of the corn; but I think not much. I always feed it at night when I feed but once a day, as I can get the cows to eat so much extra after filling themselves pretty well in the pasture through the day; and always feed in the stalls, and then each cow can get what belongs to her. I see that some correspondents have had trouble in getting cows to eat it, but I have fed it several years and never had a cow refuse to eat it, and never heard of such a thing before; and I think there is no crop that we raise here in Chautauqua that pays as well, considering the expense of raising it, as sowed corn."

Mr. F. D. Curtis.—I am pleased to find my statements indorsed by one so competent as this correspondent seems to be. Neither have I found any trouble in getting the stock to eat the corn. I scatter it about in the pasture in the evening, and think this a much better practice than feeding in quarters more confined. The cattle are thus made more comfortable than in close stables, or even in yards. In the daytime I admit the pigs, and they dispose of any refuse which may have been rejected by the cows.

Food for Birds.

Mr. Geo. J. Knight, Brownville, N. Y.—I would say to all farmers, plant a few white mulberry trees for the birds, as well as for the chickens and the children. The trees are hardy, grow fast, and bear abundantly. I will give you my experience. During the *morus multicaulis* speculation, I planted a lot of them. They soon became worthless. I saved some white mulberries near the carriage-house and granary. About the same time I planted a cherry orchard, and a variety of plum trees. They all flourished finely, and soon had fruit in great abundance. The mulberries were ripe about the same time with the cherries, and continued ripening until late in the autumn. The birds were delighted, with the white, sweet fruit, and left the cherries untouched. Chickens and children loved them. My beautiful grove of forest trees surrounding my house was vocal with the feathered songsters. I would not allow any gun to be discharged near the house or grove. The birds became very tame, sometimes sit on the banisters of my piazza and sing cheerily and merrily within a few feet of me. Their tameness was pleasant to see; none to make them afraid. In process of time my mulberry trees interfered with my buildings, and I was forced, reluctantly, to cut them away. Soon my cherries became knotty, wormy, imperfect, and but a few on the trees. The cherry trees and many of the plums evinced signs of decay; large black balls or knots on the limbs of old and young trees. They are nearly all dead now, and very few birds to be found in the neighborhood. No cherries, no berries. This I believe to be the result of cutting away those splendid mulberries. I never saw an apple tree borer in my forty-five year old apple orchard until just before I sold my farm, four years ago, and after the mulberries were destroyed.

Mr. Wm. Lawton.—I have no hesitation in recommending one mulberry tree or more for each farmstead or country house. The birds are very fond of the fruit; fowls eat it to some extent, and there are other advantages.

How to Sow Grass Seed.

Mr. Geo. P. Cash, Towanda Penn., wrote that he has a piece of land not in good heart, which was in buckwheat last year, and which he wishes to seed down, and he asked if it is desirable to sow the clover and timothy with buckwheat or alone.

Mr. F. D. Curtis.—It is nonsense to think of seeding with buckwheat; better use barley.

Mr. A. S. Fuller.—Why not sow clover alone? The idea that it is necessary to sow clover in connection with some other seed is antiquated, or ought to be. What you get in the wheat or barley is just so much wrested from the grass that needs it all. It is not best to rob the ground by trying to get double returns.

Mr. F. D. Curtis.—Mr. Fuller speaks from a horticultural standpoint. The farmer must have his regular crops, and hay must come in as an auxiliary.

Dr. I. P. Trimble.—Mr. Curtis is right, and nothing is more common in the good wheat sections, than to see, in autumn, clover growing so tall as to quite hide the stubble from which a heavy harvest had been taken ouly a few weeks before.

Mr. A. S. Fuller.—I was brought up in that best farming section of the country, the Genesee Valley, and I learned there the advantage of putting in grass seed without regard to any other crop. And

John Johnston, of Seneca Co., than whom there is no better farmer, follows this practice. It is well to put in the seed in September, and then you will have, if the soil is good, a heavy crop of grass next haying.

Waste of Fertilizers.

Mr. H. L. Reade, read the following paper:

I do not believe there is an acre of land on this continent where the manipulation and cropping has been long enough continued to bring it to the best texture, the best depth, and thus develop all its plant-producing properties, which in some cases may require a score of years, but has thereafter grown less valuable, because lacking some elements that have been taking out of the soil and never returned. In placing the grains and the grasses among the necessities of the highest civilization, the Creator arranged that, after these grains and grasses had done their part toward the sustenance of animal life, the residuum returned to the soil, in conjunction with intelligent labor, should be adequate to the growth of crops as large at least as the original production. The loss, therefore, comes from a waste of this natural supply. What are some of these wastes, and how can a saving be effected? Begin with the maw. It is impossible to accurately estimate the money value of the enriching material which comes of the food consumed in a single year by a single individual. We can approximate it by supposing the following experiment: Take a quarter of an acre of ordinary land; plant it with corn, without manure. Adjacent to this take another quarter of an acre, and in the 700 hills that would about cover it the usual distance apart, place the entire accumulation of excrement from one individual for one year, which would be not far from 200 pounds of solid matter, and from 300 to 400 quarts liquid treating them otherwise precisely alike. At harvest time weigh separately the respective crops, and, in ordinary circumstances, is there the least doubt but that the enriched quarter would yield five bushels more than the unriched, not to say anything about a portion of the plant food that would remain in the soil for the use of a second crop? I have no question but that the difference, especially when the land was considerably exhausted, would average eight bushels instead of five; but for the purposes of an experiment, we will take the smaller and the safer number. We have at least 33,000,000 of adults in this nation that consume an average man's food daily. Five bushels of corn for each, would make 165,000,000 for the whole, worth in market over $150,000,000. Nearly all this fertilizing material is lost in the cities, and three-quarters of it in the country, so that it will not be at all extravagant to say that the aggregate loss from this source alone will annually reach $120,000,000. Add to this the wasted slops from the kitchen and wash-room, and you may increase the $120,000,000 by $5,000,000 more. With regard to human excrements, I will say that the value herein given is much below that of the best European writers, and not over one-half that of the Chinese, who for centuries have esteemed this as their most valuable fertilizer, and with wonderful painstaking preserved it from waste. Now, take animals. The farmers of this country permit at least one-quarter of what comes from their cattle to be lost, and I believe this estimate far too low. I know of men at the west who winter fifty head of stock, and do not take out of their barn-yards 100 loads of manure in the spring, if they take any; and even in the most carefully and economically managed sections of this country, I think that the commercial value of the material saved each winter season, from each animal, will not exceed twelve dollars; whereas, the 2,000 gallons of urine (more or less), that a cow secretes and discharges during the twelve months, is considered worth, on the other side of the Atlantic, at least forty dollars, and should be worth thirty dollars on this, a very large proportion of which is entirely wasted. In the matter of the solid portion, after the sun and rain have had unobstructed access to it for months in our farm-yards, situated not unfrequently on a slope, many times on a soft, loamy or sandy subsoil, and always where there is abundant chance for an outflow of surplus water, its value is very much decreased. A recent analysis, made by one of the most distinguished chemists in this country, of manures taken from the same yard, portions of which were covered, while others were exposed to the rain and sun, has demonstrated that the water-soaked and water-washed portions possessed less than half the money value of those that the sun and rain had never touched. Now, take horses and hogs. Not a little of our horse manure burns up before it is incorporated with the soil; the urine of our horse-stables, among our most valuable fertilizing fluids, is not more than half saved; and as to our hogs, the noxious air arising from the place where they are kept, furnishes all the evidence of waste that is needed on this point. Add to this the droppings of our poultry, the waste of decaying vegetable matter rotting in places where its decomposition subserves no good purpose, but which would add value to the compost heap, and the aggregate assumes proportions that astound us. If the wasted enriching material of this country could be all saved and wisely applied to the needy soils, I believe it would be a safe business transaction to undertake the payment of what remains of our national debt, with the increased products it would give us in five years, thus making the voluntary taxation, which we ourselves perpetrate, pay the involuntary, about which we endlessly grumble. And here I am met by the objection coming from certain localities, that although on the poorer soils, and where the farms are small as at the east, this waste may be costly in the rich bottom lands of the great west, which God has endowed with such wonderous fertility, the case is altogether different. In answer, I have only to point to sections of this country that, once gardens, are now deserts, and to the fact stated to me by the commercial editor of the Chicago Tribune, one of the most careful observers in the west, that land in that section was growing poorer every year, and that in his belief the census of 1870 would show that all of the older grain-growing States the products per cultivated acre would be considerably less than in 1860. The west to-day is what Virginia was years ago. Who shall say that sometime in the future she may not be what Virginia is now? As to the remedy, I suggest, for the saving of human excrements, as the readiest, the cheapest, and the most easily applied arrangement of which the prairies of the country will admit, something on the principle of the earth-closet. Where the vault now is I would place a water-tight box, set on castors, that might run on a three by four joist railway, which when full could be drawn out, and from thence removed to a shed, when the material could be worked over preparatory to subsequent use. Three pints of dry earth would be ample for the use of a single person for a day, which, with a little thought, and care could be provided without much trouble or cost. As to the city, I know of no way to save the immense waste until the sewage can be utilized, as it already is in some other countries. I recommend that so far as possible the slops from the kitchen and chambers, be each day emptied on the top of a covered mound of earth, to be increased in size as often as the original mass of muck or loam has exhausted its absorbing power. I urge that every new-built barn be provided with an ample cellar, when three feet of earth can be at least annually or semi-annually deposited to hold the urine that falls from the stables above, or that some other way be devised that shall save for our longing lands this rich and appropriate food; and that when cattle are gathered at night, during the summer, they be either stabled over this bulk of loam or dry muck, which, perhaps, is the most readily available mode, or else in a yard generously covered with the same, or similar absorbents, and wherefrom, each morning, every particle of solid matter may be gathered into a pile and placed beyond the reach of either sun or rain, and over which, as occasion may require, a liberal supply of plaster, or dried earth, or charcoal dust may be scattered to hold the ammonia. The same suggestions will apply to the saving of urine in our horse-stables; and as to hog pens, they should be newly covered with fresh earth at least twice each week, and even then much that is valuable will escape. Finally, I urge every farmer to remember that the earth is not something to be ruthlessly plundered, but rather a consignment of capital to be used to the best advantage for one's own temporal comfort, the general good of the State, and the weal of mankind; and that at any loss of this capital, the result of wastes needlessly incurred, is an injustice to his posterity, an injury to the State, and an insult to the good Being who has invested him with this stewardship.

Mr. F. D. Curtis.—This is certainly a most excellent address, and, if the farmers throughout the country will heed it, great advantages will follow. The reason why European countries produce so much for so long is in no small degree because the elements of fertility alluded to are very carefully collected. We must come to this sooner or later.

Prof. J. A. Whitney.—Mr. Reade has given us a common sense and valuable discourse. It is well known that an average sample of soil will absorb about three-tenths of one per cent of ammonia, and the use of dry earth will both save manure and prevent foul odors. The utilization of sewage in Edinburgh, has raised worthless lands to a very great value per acre in twenty-five years, and caused them to yield in a single season successive cuttings of grass equal to a growth more than ten feet high. If Mr. Reade's suggestions are followed they will not only add many a bushel of grain to the the granary, but save many a case of typhoid to the dwelling.

Mr. A. S. Fuller.—The sewage question is a question of the cost of labor. What may answer in countries where labor is twenty cents a day might not answer at all well were labor ten or fifteen times as much. I can go down to a muck bed and for fifty cents get as much fertility as it would cost me a dollar to save. When the relations of man to land changes, as they will, and we are crowded as Europe now is and China has been for ages, we shall take a practical view of this subject. But human wastes will not be all saved and applied to agriculture till human muscle is a cheaper commodity than it now is in America.

Mr. J. B. Lyman.—I hope the remarks of Mr. Fuller, which, in one sense, are just, will not curdle the pure and sound teaching of

Mr. Reade in the minds of those who hear. It is like saying that good strong padlocks will be used on all stable doors when horse stealing becomes an epidemic crime, or that wind-mills will do all the grinding when the coal is burned and the river-water has run into the sea. I am aware that the toil and curse of agriculture is to restore desolated lands, to give back fertility that has been wasted. The soil is a bank. Properly used it will never break. But in this country we are running the old race that has made a desert of Syria, and Greece and half of Italy. We run upon the bank and break it, and then puzzle our brains and strain our backs in trying to set it up and make it solvent. Mr. Fuller says, as wages are it won't pay to use small economies about manure. I differ with him; the best farmer I know in a neighboring State differs from him. He keeps from twenty to thirty cows, and sells milk to a city five miles from his farm. He has put up a model barn at an expense of $3,000, and laid the floor in cement that he may save *all* the manure his cows make. He hauls muck three miles, keeps it in a cellar, and rolls it in a barrow behind his cows, throwing it in the gutter under their heels. It absorbs and deodorizes the manure, and gives him twice as much as he had with the old wasteful system. In this way he has raised the value of his farm from thirty-five dollars an acre, the price his father reluctantly gave, to $200. He finds it actually worth $200, because an acre will grow 800 bushels onions and 1,000 bushels of beets. He never does a thing that will not pay, any more than our thrifty friend Fuller, yet he makes it pay to save and compost all his fertilizing matters with the utmost care, and is growing rich by so doing, on lands where the former owner grew poor. He says he cannot afford to have *any* waste of manure.

The Chairman.—We need not ramble from home. Mr. Reade has told us how to utilize that which is now an offense. He has given me some hints which, if I live, I shall put into practice.

Cure for Red Murrain.

Mr. D. Harrington, Norway, N. Y., has a herd of cows afflicted with this disorder, and he came to the Club for information.

Mr. A. B. Crandall.—Lewis F. Allen, in his work on American cattle, states that purgative medicines are the best remedies, and he recommends a mixture, consisting of castor-oil, six ounces; nitre, one ounce; epsom salts, four ounces; whey, or thin gruel, one quart. If this does not prove effectual, a drink may be administered, made of two ounces oil of turpentine, one ounce of alum, dissolved, and one ounce of terra japonica. Harris Lewis advises sulphur and salt, and another writer states that an experienced farmer gave half a pint of the juice of the white-blossomed nettle with excellent effect.

THE PHILOSOPHY OF VICTUALS.

Mr. A. L. Park, Gardiner, Me.—A book having a wide circulation, "The Philosophy of Eating," by a physician of Boston, contains some important statements on which the opinions of the Club are solicited.

This writer says that wheat flour loses in the process of bolting its most essential elements, the phosphates, nitrates, and iron, all being contained in the husk which is rejected. Butter, also, in being churned, has lost all the valuable parts of the milk, which go off in the buttermilk. If these statements are true, then bread and butter is very imperfect food, and the doctor is called on to explain the fact, that the thousands who make this a yearly and almost exclusive diet, and are yet strong, bright-minded, and long-lived. If the ideas of the writer are all sound, the most significant reform now needed in our nation is the disuse of such food, and the substitution of coarse flour, or of wheat and milk prepared somehow, so as not to lose all their most precious elements.

I have suspected that these statements, though apparently founded on chemical analysis, might somehow be at fault; for otherwise so many men who live almost wholly upon bolted flour and butter would not be able to work and think as they do upon such a diet. Will you give the people the facts upon this extremely vital question?

Prof. J. A. Whitney.—Wheat does not lose, in the process of bolting, its most essential elements, because these are distributed throughout the kernel. Ninety-eight per cent of wheat is organic matter; starch which supplies fuel to keep up the animal heat and gluten, which, as it contains nitrogen, builds up the muscles, or in other words, makes red flesh. The ash or mineral part of the grain is nearly one-half phosphoric acid which enters largely into the composition of the bones, and also nourishes the grain. The average quantity of bran from a given weight of wheat in grinding is about twelve per cent, and of this one-half is really coarse flour from the interior of the grain, leaving six per cent of husk. This husk, according to critical analysis, is more than fifty per cent, starch, gum and sugar, having no greater nutritive qualities than the starch in the flour, about fourteen per cent more of the husk is moisture and three per cent oily matter, having much the same properties, as far as nutriment is concerned, as starch. Nearly ten per cent is woody or ligneous substance. There is, however, about six per cent of mineral matter that undoubtedly contains some phosphoric acid and fourteen per cent of nitrogenous or glutinous matter, but these exist in a very insoluble form; and when we reflect that including the heat giving elements, starch etc., the entire nutriment of the husk is less than twelve per cent of the entire grain, and that by far the most of it is indigestible, the statement, that flour loses its most essential part by bolting, will appear in its true light. I do not believe that the husk of wheat or any other grain is fit for food for anybody. What farmer would feed a working horse on wheat bran instead of oat-meal or ground corn? It is, however, much to be desired that some means of saving the flour mixed with the husk in the bran should be devised. Many attempts have been made to do this by removing the husk before grinding, and it is likely that some day this will be done extensively. With regard to butter, it is like all other facts, an equivalent for starch or sugar in maintaining the animal heat, while the nitrogenized matter, casein, which exists in the buttermilk, goes like gluten, to supply material for the muscles or red flesh.

Only sixty-five per cent of butter is oil, the rest is matter which is nutritive, or which aids other parts of food, to assimilate. Hence the statement, or the inference that good wheat bread and butter is imperfect food is not correct. But I would not say a word to discourage the use of food that is known to give bone and red flesh, especially for children. There are no finer looking children than those who have all the milk and cheese they want. Their eyes are brightest, their muscles firmest, and their heads the clearest. Cow's milk will be the leading article in the food of that much talked of coming man, that prince of a golden civilization, who eye to eye shall look on knowledge.

RAISING WATER FIFTY-THREE FEET.

Mr. E. L. Briggs, Grand Rapids, Mich., asks how he can do it.

Prof. Whitney.—He can raise it by suction for the first thirty feet, and the remainder of the way by a force-pump; or he can put a force-pump to the bottom. He will have to work it by hand, because we have not yet secured the cheap power which is so much desired in such instances.

ASHES FOR SWEET POTATOES.

Mr. J. C. Corn, Cameron, Clinton county, Mo.—Are ashes good to apply as a top dressing for sweet potatoes? If not, what does the Club recommend?

Mr. J. B. Lyman.—For sweet potatoes he must have stable manure, unless his soil is rich. Half a shovel in the hill is enough. The soil should be sandy. If it is very long and strawy it will push the vines by its decay. Ashes may be good, but they are not prized or sought by successful growers. They are a special fertilizer for round potatoes, corn and grass.

MARKETING GRAPES.

Mr. J. Askham, Phelps, Ontario county.—I have a young vineyard containing about 1,500 vines, mostly Concords and Delawares. They are all in bearing this year for the first time. Will some member of the Club please tell me what kind and size of package is best for shipping? Should the boxes be tight or ventilated?

Mr. Alex. Palmer.—He wants boxes to hold three pounds and five pounds. The best are of veneer, but paper is mostly used. Put them in carefully, full but not crammed. Pack in crates, or if the boxes are stiff nail three cleets to a dozen. Mark neatly. Fairchild of Hammondsport, makes an excellent grape box. Handle the Concords like eggs, for they are very apt to burst their jackets.

FRUIT SAFE.

Mr. L. W. Nichols, West Sterling Mass., exhibited a fruit safe for sending choice fruit to market a very valuable invention.

FOLDING CRATES.

Mr. L. A. Lindsay, 58 Broadway, exhibited a folding fruit, vegetable and poultry crate, and packing box; which were approved.

Adjourned.

May 31, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

BARLEY.

The first letter read was from Mr. L. N. Hager, Mill City, Nevada, and stated that barley is the staple article of food for horses and mules on that far coast. It is fed in all shapes, whole, soaked, boiled and ground, and it is claimed by those of experience to be better for a horse than any other grain. "When our barley is cut, it is left in bunches as it comes from the machine, or if cut by hand it is bunched the same as if for binding. When fit to haul a large wooden fork is used to put it on the wagon. Three years ago I had barley that was estimated to yield 100 bushels per acre. My whole crop of forty acres yielded more than forty bushels per acre, and ten acres were down so bad that it did not more than half fill. I do not agree with A. W. Thomas, of Troy, Pa., as to the amount of seed to sow. I sow from eighty to one hundred and twenty pounds per acre, regulating the amount of seed to the time of sowing and the quality of soil. On rich, moist soil, a small amount of seed will answer, particularly if sowed early. On dry, light soil, I have never been able to sow too much seed; in fact, I have always thought that more seed would have been an advantage to my poor soil, and I have concluded to put in more seed on light, poor soil, every year, and shall continue to increase the amount until satisfied.

Miss Marwedel's Horticultural School.

The following communication was received from Mr. S. Edwards Todd, Brooklyn, L. I.: I had calculated to be with you to-day for the purpose of giving some account of my late visit to Brentwood, which place, as you know, has been selected by Miss Emma Marwedel, as the most desirable and encouraging locality for the establishment and ultimate development of a horticultural school for ladies. When Miss Marwedel went to Ithaca to select a location, all my confidence in her as a practical horticulturist, and also in her enterprise, utterly failed, as I felt that such a cold locality, and such a heavy, rough, stubborn, and compact soil as we find on the hills around about the Cornell University, could never be made congenial to the fundamental requirements of such an institution. But when I came to see the magnificent garden soil at Brentwood, I felt that this lady is master of her profession, as the ultimate success of such an institution must depend, first, on the congeniality of the climate; second, on the adaptation of the soil to horticulture; and third, on the zeal and enterprise of the founders. Of course, the school is yet in the embryotic state, with only a few pupils. But the soil is of such a superior character in all that region that, with only the natural resources of the land, its fertility can be improved, from year to year, so that agricultural, horticultural, floricultural, and pomological operations may be conducted in the most satisfactory manner. The climate is delightful. As all that locality lies, as it were, in the very bosom of the sea, there is nothing to endanger the first crop, except the "little Turk" and caterpillars. The Long Island railroad runs directly through the village, which is laid out in broad streets and beautiful avenues. In one respect, the place is a kind of Vineland, N. J., as no fences are required to protect the beautiful flower gardens, and vegetable gardens, and broad acres of luxuriant meadows, and velvet lawns, some of which were being mowed, even at that early date, the 19th of May. In the nursery of Mr. Richardson, we saw large numbers of all kinds of fruit and ornamental trees which seemed more hardy and healthful than in any nursery we had ever visited near New York city. The chief, secret of this seemed to be attributable to the fact that very little manure is required to promote the growth of trees in such a soil. Judge J. L. Smith assured us that more abundant crops can be grown there, with a given amount of manure, than in Massachusetts. And I am sure, from what I know of the soil in the wheat-producing county of Tompkins, that the soil on Long Island will yield more grain or grass, if both receive an equal dressing of manure than the soil of Tompkins county. Miss Marwedel has received many encouraging words from the Club; and she desires especially, that our chairman, Mr. Bragdon, and Mr. Fuller should visit the locality and give her still further encouragement, if not material aid. As she seems to be a lady of rare modesty, as to extending invitations to single men, I will take the responsibility of putting in an invitation to Professor Whitney, Mr. Quinn, and to Mr. Crandell, to go and see for themselves. I feel assured that in a few more years, Long Island will become one vast pleasure ground. The gloious work has already begun. "Old Time" has been waiting for this auspicious era to dawn, when the wilderness and the solitary places shall rejoice, and the desert shall blossom as the rose.

TREATMENT OF TOMATOES.

Mr. D. A. Compton, of Hawley, Pa.—Do not forget to tell your agricultural friends that tomatoes on heavy soil may be obtained from four to five weeks earlier than usual by setting the plants on the top of sharp hills. The hills should be about fifteen inches high and three feet diameter at the base. Water the plants only when first set, and dust the plant and whole hill frequently with plaster. The tomato, coming from a hot and dry country, will endure a drouth that would prove fatal to less hardy plants. What it needs most is heat; and this is secured by planting on steep hills, on which the sun's rays strike less obliquely than on flat surfaces. Land should not be over rich for the tomato, very fertile soils producing too great growth of vine. The vines should be "pinched in" and the blossoms removed after the first settings have attained the size of marbles; but in any case the vines should be permitted to fall directly on the ground, that the fruit may have the full benefit of the heat of the sun and the warmth refracted from the earth. By saving the first well-formed ripe tomato for seed for several successive years, a variety may be obtained that for earliness will be far superior to the original stock.

Mr. F. Copeland, of West Denham, Mass., having seen the inquiry, "Will salt injure tomatoes?" was induced to forward the following item of experience: "Last season I had about a quarter acre of ground so filled with sorrel that I thought nothing could be done with it. I broadcasted very liberally salt and lime, as near as I could judge, without actual measure, two parts lime to one salt. This I plowed in. On this land I planted early cabbage and tomatoes, of course using manure liberally, and it is the first season for eight years that I have had any really good tomatoes. The vines were very prolific, and the fruit large and exceedingly fair. I shall follow the same plan with my tomatoes this year. I would also say that the crop of sorrel was completely killed out. I have used lime and salt on a mowing field to exterminate sorrel with perfect success."

Seed Potatoes.

Mr. J. W. Brigg, of Macedonia, N. Y., "has occasion to smile frequently at some of the theories taken for facts by certain members of the Club; but then the practical farmer regards theories as suggestions worthy of consideration and tests. There is scarcely a farmer in all the country but could say something of his experience in potato culture that would be interesting. The sweeping theory, or 'rule,' as Mr. Greeley calls it, 'that in almost all plants small begets small and large large.' The reason (by Mr. Greeley on the discussion, April 26, in relation to large and small, cut and uncut potatoes for seed), small potatoes had not got their growth, 'was not perfectly ripened.' By this theory a potato the size of a pea could not be expected to produce large potatoes; but facts are widely at variance with theory. In the spring of 1868, I paid three dollars per pound for Early Rose potatoes, and produced a full barrel from each pound of seed. They were all small potatoes, none larger than a small hen's egg, and cut to single eyes as near as could be. Some of the pieces were not larger than a grain of wheat, yet the product was very satisfactory as to size and quantity. On the ground where these grew there sprang up in the spring of 1869 plants of this variety, which were removed and transplanted, with the potatoes attached. These potatoes were of the size of a marrow fat pea to a filbert, none larger, and yet the product was as large, as symmetrical, and as good as from our other plantings of the same variety. Hence the theory of small potatoes producing small and large is not supported by facts. This subject is not exhausted by a great deal, and farmers should compare notes, accompanied with facts. The best way of doing this is through the reports of your Club."

Mr. A. S. Fuller.—He did not see the ill effect in a single season, but let him follow the practice up for four or five years, and I apprehend he will have a somewhat different story to relate. It is the principle which is wrong, and the bad results are sure to come, even if they are long coming. It is as true in this as in theology, time that either degeneration or progression is a gradual growth; neither is reached by sudden leaps.

THE WOODPECKER.

Mr. J. R. Lefever, Greencastle, Iowa.—I have noticed that where the Colorado bug infests the potato vines the red-headed woodpecker is of incalculable value, being a greedy feeder, and partial to bugs as food, and, until recently, could not see that any other animal or fowl would feed on these pests; but, as he does not go very far from timber, perhaps those residing on open prairies might not be benefited by his labors. So I would advocate the protection of the woodpecker, although he injures and devours much corn. Whether crows, blue-jays, cat-birds, and the immese flocks of starlings, common all over the west, are more beneficial or injurious is, with me, an open question. Hope to hear from others.

THE CROW.

Mr. Ira Brewer, Binghamton, N. Y.—I have long noticed the habits of the crow, the bird that no person ever knew to do any damage except to pull up a few hills of corn. I own I have been vexed with him, for, after trying every expedient to frighten him, he would return and have his frugal meal. Noticing that it was only his breakfast he required, I scattered some corn on the very spot that he always visited, and he uniformly returned each morning and ate his supply; and it was worth all it cost to hear him laugh and "ha! ho!" over it; but he never pulled any more corn, but seemed content with his frugal meal. After that I tried no other remedy, and found this sufficient. When we take into consideration the value of this bird as about the only scavenger we have in the rural districts of the north, away from the seaboard, to say nothing about his habits of destroying worms and other vermin, I think we can well afford the little trifle that he calls for; he is, indeed, the only bird that braves the tempests of our northern winters, and his familiar habits about our farm-yards, when the thermometer stands at zero, make him an object of interest; but this bird is becoming scarce, and, if his destruction is continued, is likely soon to become extinct, like the downy woodpecker.

Dr. I. P. Trimble.—Farmers who expect to prevent their corn from being pulled by scattering kernels on the surface should take the pains to make them soft by soaking. The crows gather the corn for the purpose of feeding their young, and they reject what is hard and go for what is under the ground, because it is likely to be softened.

Mr. H. L. Reade.—Dr. T. says true. Crows will pull corn rather than touch the kernels which are hard, as seed is apt to be. Persons who wish to adopt a different practice in order to prevent the ravages of the crow, may imitate our New England farmers, and stretch a twine around and across the field just after planting. Another plan in vogue among them is to put up here and there an effigy resembling a man, as much as it resembles anything in the sky above or the waters beneath. Others tie up newspapers to frequent posts, and find good effect therefrom.

Mr. F. L. Curtis.—It is the practice in northern New York to roll the seed-corn in tar and dry it off with plaster. It don't come up quite so quick, but it is never disturbed. I don't think it well to frighten the crows; on the other hand, I like to invite them, because I feel reasonably certain that they save more corn in one year because of the grubs they gobble up than they destroy in a quarter of a century. And yet there is great ignorance of this fact, for only a little while ago a deacon in our church boasted to me that he had killed crows by the dozen by scattering some corn soaked in strychnine. I was shocked. I may put it stronger, and say I was horrified

Onion Culture.

Mr. Byron Archer, of Hillsdale, Mich., asked concerning onion culture, the kind of soil best suited, and "all the *modus operandi*."

Mr. A. B. Crandell.—At Wethersfield, Conn., I met a gentleman who has attained great success in the culture of this crop. He says the soil must be remarkably rich, and the richer the better. If kept at the proper point of fertility, repeated crops may be produced on the same ground. He continues to plant onions in a bed which has been used for the same purpose for at least eighty years, and he has found that the finest and longest specimens come from the oldest gardens. His favorite patch is manured each season at the rate of thirty cart-loads per acre. The soil is not less than a foot in depth. His practice is, as soon as the frost is out, to use a subsoiler, which goes two feet deep; a little later to put in a plow, which goes down about four inches; then make the surface smooth and mellow, and plant as early as possible in rows from eighteen to twenty inches apart. For this purpose the Wethersfield drill is recommended, being cheap and efficient. The cultivation commences about three weeks after seed is sown, and one of the great principles is to keep the onions perfectly clean. Generally, three times weeding will be sufficient, and the crop need not receive attention after the tops shade the ground. The harvesting is done in September; and the best way is to make heaps of forty or fifty bushels each, cover with straw, and leave in the field for a month or more. Six hundred bushels to the acre is a large return, but under the most favorable circumstances 800 bushels can be produced. For next year's crop it is well to ridge the ground in the fall and split the ridges in the spring. For new land the best plan is to begin two years ahead and pave the way with corn and afterward a crop of potatoes. The best manure is that obtained from cattle stalls. Occasionally, if the young blades look pale, a top-dressing of Phœnix guano may be applied with advantage. The surest crop is the Red Wethersfield, a variety which is large, hardy and strong. For raising seed the same richness of soil is required and the same strict attention to culture. The onions are set as early as possible, in rows forty inches apart, at the rate of 250 bushels to the acre. They can be freed from weeds by the use of a horse hoe. When the tops are ripe enough they are clipped off, dried under shelter, thrashed out, and run through an ordinary fanning-mill.

SALT AS A FERTILIZER

Professor Charles Eggert, of Iowa University, Iowa City, expressed the belief that the following facts might serve as partial answer to certain inquiries: 1. Neither of the two elements of common salt, chlorine and sodium, is found in the majority of plants. Sodium exists only in the sugar beet and in certain plants growing near the seashore, etc. (salsola, salicormia, etc). These plants, including the sugar beet, belong mostly only to one family, the Chenopodœ. Ever since the Frenchman Peligot (vide Transactions of the Paris Academy, November, 1867), examined this matter, the fact, as just stated, has not been contradicted. Neither the grain nor straw of wheat, nor the wood of the oak, the leaves of the tobacco plant, nor the roots of parsnips, nor the tubers of the potato, contain any sodium. Although all plants contain largely potassium, and this element is so nearly akin to sodium, investagations have satisfatorily proved that, in most plants, the latter can never be substituted for the former. Certain sea plants that contain sodium can be easily made to substitute potassium for it, but not with *vice versa.* 2. Experiments with pure salt have demonstrated the fact that the soil is not benefited by it. Cases seemingly in contradiction with this fact are known, but they formed no exception, inasmuch as salt is often impure, and its impurities, particularly magnesia, one of the most powerful mineral manures, have been proved to be the real cause of the beneficial effect. 3. There is, however, one possibility left where salt may directly aid vegetation, viz., when the soil contains at the same time a great proportion both of lime and organic nitrogenous substances. In such a case there will be formed, of the carbonate of lime and the chloride of sodium (salt), chloride of potass, and carbonate of soda. The latter by oxidizing, affects the organic matter, and thereby changes, sometimes in little more than two months, into what is well known as Chili saltpetre, a most valuable mineral manure, by virtue of the nitrous and phosphoric acids it contains. Without the salt this process would likewise take place, but it would require very much more time.

PRESERVED MEAT.

Mr. J. B. Lyman, showed a can of preserved meat prepared by the process invented by Mr. A. S. Lyman, of New York, long known for his ingenuity and industry in devising methods of supplying the eastern cities with flesh from the prairies. A year or two ago, Professor Gamgee came hither from London with notable sound of the trumpet, and was about to set up the fresh meat market systems of the two hemispheres. It is a matter of pride for us, that a quiet and skilled American chemist has been able to show the defects in the Gamgee patent, and to supply them by ideas at once scientific and practical. A company has been organized, the capital mostly supplied by Mr. David Lyman, of Connecticut, who has set his heart and his noted business force at the problem of making meat food cheaper for the million, and they have an establishment at Houston, Texas, where a bullock that will dress 600 pounds can be bought for thirteen dollars. Mr. Lyman requested Mr. J. A. Richardson, the manager of the establishment, to speak more fully of the method.

Mr. Richardson said: The central idea of Mr. Lyman, in all his plans for the transport of fresh meats is this: He believes that decay even begins as soon as the amimal dies, and is greatly hastened by the waste that is always going on in the system, the waste that is consistent with perfect health, and which death arrests. This he calls the normal waste, and says, the first thing to be done with a carcase is to get rid of this waste. He does it by placing the flesh in an exhausted receiver, when the air that was held in the little cells comes outward, driving the normal waste before it. This first process over, meats may be preserved by keeping them at the temperature of thirty-nine degrees or lower, by the use of certain gases, as the carbonic, or by the application of heat. We propose to forward meat from Texas, and other grazing countries, by using the two latter methods, and to some extent the former method, *i. e.*, by cold. In these cans, closely sealed, we put the flesh of a bullock that will dress 600. He costs us about thirteen dollars, and we reduce the bulk of his clear flesh from 600 to 200 pounds by our method of cooking. This is a sort of beef a-la-mode, and in this state can be taken around the world. All the nutrition in the animal is here concentrated and preserved in a condensed and wholesome, and quite palatable form. A good cook will prepare and combine it for the table in various appetizing forms.

ORCHARD GRASS.

Mr. Frank D. Curtis put in a plea for orchard grass, saying he has found it excellent, especially in pastures. He spoke of one field in particular, in which he tried in vain at different times to get other grass to grow, but when he scattered the seed of this variety his troubles in this respect were ended. A thrifty growth appeared, and now early each spring there is such a thick carpeting of green as is delightful to look upon, and to which stock is especially devoted. Mr. Curtis expressed his doubts as to its being so valuable for hay as the old mixture of timothy and clover, but for pastures it is certainly unsurpassed, and it is also excellent for shady places and in sandy soil where other grasses fail.

Adjourned.

June 7, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

INCREASE OF INSECTS.

The chairman introduced business by reading from an article, written by Mr. William Cullen Bryant, in which the multiplication of insects was commented on, and in which the opinion was expressed that one of the chief causes of this increase, and the attendant comparative failure of fruit crops, is the wanton destruction of birds. There is nothing for us to do but to take our winged allies into partnership, allowing them a part of the annual product on condition of their protecting the remainder, as the traveler in the east pays a tribute to the Bedouin chief on condition of being protected by him from the robberies of his tribe. We must make choice between the insects and the birds. Birds multiply with comparative slowness, and if they prey upon the crops they can be seen and scared away. Insects multiply by myriads, and evade the attempts of man to destroy them. Birds take a small part of the fruit or ripened grain; insects destroy them by wholesale. But, even if the crows only were destroyed, the effect would be mischievous. Crows feed upon grasshoppers, crickets and other insects, and their stomachs are found full of them. A single insect which escapes them becomes the parent of thousands, and each one of these is the progenitor of thousands more, which move silently and surely to the work of destruction. Even the uprooting of a few corn plants would be a loss of far less consequence than the mischief from millions of destructive insects propagated without check. The chairman also read another extract, in which allusion was made to certain experiments made in Australia, proving that the crows consume great numbers of caterpillars, whose ravages would otherwise be quite apparent upon the wheat crop of that country.

BUCKWHEAT.

Mr. W. F. Howard, Boonville, Mo., inquired concerning this crop, which, he stated, is very little known in his section of "the greatest country the sun ever shone upon." How much seed to the acre, when should it be sown, and what is a fair yield, and when shall manure be applied? Mr. S. C. Davis, Medina, N. Y., asked similar questions, and especially, "Is it advisable to sow buckwheat in a peach orchard; will it injure or benefit the trees?"

Mr. S. E. Todd.—When I was farming in Tompkins county I put in a number of crops of buckwheat, and got from forty to fifty bushels to the acre. My practice was to prepare the land as well as for any other crop; use three pecks of seed per acre (this quantity is better than half a bushel, because the straw is less likely to get tangled), putting it in from the 20th of June to the 5th of July. However, I am bound to say I would have been better off had I omitted buckwheat entirely, and given the time to almost any other grain. Buckwheat exhausts the soil very much, unfits it for further use for a year at least, and the only recommendation it has is that it clears the soil of foul growth.

The Hon. George Geddes.—I certainly would not advise any farmer who lives in such a good country as Missouri to give attention to buckwheat. As near as I can learn, buckwheat is only grown by people who are so unfortunate as to occupy poor land. They can't get anything better, and so grow a little buckwheat.

Mr. J. B. Lyman.—In peach orchards it is the best crop that can be put in, as it robs the soil of nothing that the peach wants, and keeps out daisies and sand-burrs. By the time buckwheat is put in, a light plowing will not hurt the orchard. But in May and June the roots should not be disturbed, as it will cause the little peaches to fall.

Mr. Frank D. Curtis.—As most who have spoken have seen fit to give the crop in question a kick, I am willing to be in a mean minority, and speak a word in its praise. My observation has convinced me that in localities where wheat cannot be easily grown, buckwheat is a very profitable crop. Thousands of bushels are grown each season in northern New York, and the crop has been growing in favor for the past five or ten years. No grain is so excellent to prepare the way for an oat crop, the only trouble being that occasional kernels sprout the season after. It is excellent feed for fowls and for farm animals generally, especially in winter weather, because of its heat-forming qualities, and a man with his belly full of "buckwheat cakes, brown," can walk further, jump higher, and chop more cord wood, than if he make his breakfast on any other food.

AN IMPROVED MARKET SYSTEM.

As a member of the Committee on Market Abuses, Mr. F. D. Curtis read the following paper:

In discussing this question, I shall not assume that the commission men, who handle the products of the producers, are dishonest, or that their dealings are generally fraudulent, which is, undoubtedly, sometimes the case; but I shall find fault with the system, and try to point out a better plan for the farmer and dairyman, in which the opportunity to defraud shall not exist, and in which the door of temptation, so wide open in the old, shall be effectually closed. A change of base will be necessary; for, under the old plan, the middle-man does business with the capital and at the risk of the producer, while, under the new, the capital and risks must be his own. The consumer, or his factor, must meet the producer with his products on his own vantage ground. With the present system, the commission merchant, in order to start his business, requires no capital beyond the ability to rent a store-room in which to receive his consignments. The confiding countryman, who has a barrel of whatever it may be, sees the advertisement of this dealer, or hears of him through some source, and ships to him, as per directions, his hard-earned little surplus. We will follow the barrel *en route* to its destiny. It is carried by our trusting farmer to the railroad depot or to the steamboat, and duly consigned to the fostering care of a freight line, or perhaps our example has more faith in the responsibility and dispatch of the express, and commits his expectations to this gourmand, C. O. D. A day, or part of a day, spent to start our barrel, must be charged to the account of loss and gain. Next comes the freight-bill, then the cartage. Our barrel costs as much to cart it from the place of arrival to the place of consignment as if it had been a full load, and had had a dozen traveling companions. It is tumbled into the store, where it modestly keeps silence and waits for future developments. In due time its head is knocked in, and it stands in the mart waiting to be bought. No words are wasted or time spent in this transaction. The value received is placed to the credit of the waiting farmer, less the freight, cartage, and insurance; for, mind you, it is a part of the system that the merchant runs no risk. Our barrel must do its part. To their charges must be added the commission and portage, and then the account of sales is ready to go forward and the pay. The history of one barrel is the history of a million. The example of the one package is the illustration of the whole. It is a jug with the handle all on one side. If our middleman has been speculating on his own account, his goods must go first. The stranger can wait. With a prospect for some years to come of low prices, the farmer needs to study closely the cost of marketing his produce. He must, if possible, get rid of the expense of commissions and driblet marketing, and the proportionate increase of cost for freight and handling. Before his goods are shipped and handled, they should be aggregated to large amounts and favorable terms, and arrangements made for moving them forward to commercial centers. In this way the relative cost will be materially lessened and the home value increased, which cannot be the case when each farmer sends his own surplus forward, each for himself. The curse of agriculture is its universal disintegration, both in theory and in practice. It is not practicable for the producers to unite and send forward their combined products under the charge of one of their number. When he reaches the market he has no customers to whom to sell, and he would be at the mercy of every sort of trading parasite. There are laws in traffic, fixed by statute and usage, which the novice would find barring his way and disappointing his purposes. The city dealer must be brought to the neighborhood of the producer. To do this, market days and market places must be established at home. Quantities can be accumulated, and wholesale handling follow, with cheaper freights, cheaper cartage, no insurance for the farmer to pay, for this will have to come out of the merchant's profits. There will be no storage to pay, or risk of loss in transit, or of final payment. An important benefit not to be omitted is, the mutual advantage to both parties in being brought face to face, where explanations and instructions can be given; if butter and cheese are the staples, hints about the manufacture and packing; if fruit, how to assort and prepare, and so on through the list. The owner who is forced to take a less price can see the reason why, by contrasting his articles with his more painstaking and successful neighbor. Standards of taste and requirement will be created. When the new system shall be established, the consumers could unite their wants, and, sending an agent to the market-place on market-day, purchase for themselves, and ship direct to their own doors, the articles required. The yearly stock of apples and potatoes, and many other household necessities, in this way could be obtained at a much less price over the present multiplied handling and multiplied profits. You are, doubtless, ready to ask, can this radical change be made in our market system? It is possible anywhere. It is a successful reality in several counties already. Mr. X. A. Willard, whom I consider the highest and best authority on the general subject of the dairy in this country, writes me regarding the new system of marketing in Little Falls, N. Y., that "it was established fifteen years ago by common consent of dairymen and cheese dealers. We at first had two days in the week, Monday and Wednesday, but recently only one day, Monday, is set apart as market day. Buyer and seller meet here on that day; the dairyman bringing in what goods he has to sell, and the factoryman making sales for future delivery, the latter sometimes bringing samples, but generally selling on the reputation of the factory. The great convenience to both parties is manifest. It has been proposed from time to time to have dairy products sold here on market day by auction in order to expedite business. There would be some advantage in this arrangement. Some think abuses would be liable to grow out of it. We think that, on an average, higher prices are realized than by the old system, since a large number of dealers being present, there is more competition for 'fine goods,' while the price of the best samples having been made, the poorer sell better. Again, there are always dealers present who are engaged in purchasing second-rate goods at lower prices. The management of the sales is very simple. The farmer drives his load on the market grounds, and the different dealers come round and make examinations and name the price they will pay. The one making the highest offer gets the lot, and the load is driven off to the freight-house, weighed, and paid for on the spot. This makes clean work." Lewis county has begun this year for the first. I have no particulars from there, but Mr. S. R. Pratt, the accomplished secretary of the Adams Farmers'Club, in Jefferson county, informs me that both at Adams and Watertown market days have been established. Mr. Pratt says: "Our market day is Tuesday, and has been established since the first Tuesday in April. The experince of the first day delighted our farmers with the system. The result in Watertown has been good. Their market day is Saturday." At St. Albans, Vt., they have also market days for the sale of dairy products. I regret that no one there responded to my request for information. I do not expect that the new system can be applied to all sections of our country, or to all the multiplied and various commodities produced in it, but it can be utilized and applied extensively enough to save to the toilworn farmers thousands of dollars, if they only lay hold of their opportunities and privileges. The agricultural fairs can be lifted to a higher plane of usefulness by combining with the show a sale. This can be a sale of everything, stock, grain, implements, etc. The sale can be made a feature and an attraction, and be under the control of a committee, to work upon business principles, rounded up to a business success. This idea was inaugurated last fall at the Saratoga county fair, and, although the day was rainy and the notice limited, I sold myself, nine head of cattle, beside swine and poultry. To make success sure, a revolution in the system of farming in many localities is required. Driblet marketing is the result of driblet farming, the most costly form of agriculture. No township prospers under this mistaken notion that the farm must produce a little of everything. A little of everything produces a financial nothing. Adaptation of growth to locality and aggregation of quantity are the only sure methods. If the soil is fertile in grasses, then the growing of beef or mutton, or dairy husbandry, should be followed. If there is a natural adaptation to the cereals, make them the mainspring of effort. If the climate favors a special product, unite in the production of that. No class of people are so open to imposition as the farmer. It does not arise so much from ignorance or stupidity as from the want of association and varied intercourse. A more frequent lookout from his limited sphere would sharpen his understanding, and fit him to cope with the wily world's man who has polished his wits to perfection. I would recommend public meetings at which this whole matter could be considered, and an agreement had to unite in the cultivation of crops adapted to soil and locality, and the establishment of market days at the most central points for shipping. When this excellent foundation is laid, an agent could be sent forward to notify dealers and request their attendance. If failure had haunted the fireside, success would take her place, and rekindle the cheerless embers into renewed life and vigor.

Prof. Nash and Mr. Lyman warmly indorsed the paper read.

Mr. Gregory wanted the government to take charge of the fruit delivery business in connection with the post-office.

Mr. George Geddes said the entire power of the Russian government could not supply the city with fruit as well as it was now supplied. We would starve if the government attempted to supply us. The paper was a valuable one, and would set the farmers of the country to thinking.

HAY AND HAY-MAKING.

Mr. S. E. Todd, bringing a tuft of well-curved, bright looking hay spoke of the importance of the subject: No grass can be put through any process to improve its delicious quality, or to render the nourishment contained in it more available to the animals that feed on it, than strawberries can be improved by cooking. Hence, the nearer hay approximates the condition of the green and luxuriant grass the more fat, flesh, bone, muscle, butter and cheese a given quantity will produce. Now, then, to make fragrant, sweet-smelling hay, we need only evaporate the water contained in the leaves and stems. And this process of drying needs to be conducted with as much carefulness as our domestics dry our linen after washing it. Making hay is only curing herbs on a large scale. Our good wives and mothers have the whole science of hay-making in a nutshell, when they prepare the aromatic peppermint and the fragrant pennyroyal for medicinal purposes in the winter. The main idea in making fragrant and sweet-smelling hay is to keep the grass flying in the air with the tedder or forks, so that every stem and leaf will get a few hours only of sunshine and the benefit of the drying breezes, which will carry away all the vapor, leaving the gum, sugar, and starch as sweet and dry as is the delicate material in the kernels of grain. It injures hay to sweat and heat itself dry, as much as to allow grain to heat while in the bin.

Mr. H. L. Reade, remarking the timeliness of good views on the subject, proposed that the Club make hay and hay-making the special order on next Tuesday. We wish to know whether good hay can be made by salting half-dried grass, or by liming it, or by treading it in tight bags?

Prof. P. H. Vanderweyde exhibted some fossils taken from the mineral phosphate deposits near Charleston, and made some remarks touching the agricultural value of said deposits.

Paris Green for Potato Bugs.

Mr. N. E. Doane, Cromwell, Ind., wrote that the potato beetle or Colorado bug is doing much damage in his locality. "What shall we do?" Mr. Wm. L. Condit of Tremont, Nebraska, told a similar story and asked advice.

Mr. A. B. Crandell.—Dr. LeBaron, the new State entomologist of Illinois, contributes to The Prairie Farmer an article advising the use of Paris Green for the pests complained of. It should, he says, be mixed with wheat flour in the proportion of one part of the former to six of the latter, though as low a proportion as one to ten has in some instances proved effective. Another correspondent of the same journal, Dr. W. B. Baldwin of Elgin, who had considerable practical and eminently successful experience in the use of Paris Green for the purpose indicated, states that it is his custom to mix it with equal weight of finely sifted wood ashes; fill a wide mouth bottle, over the mouth tie a piece of bolting cloth, such as is used by millers in making flour, or "six-penny muslin" might answer as well. When the plants are wet with dew, or dampened with watering-pot, sift on the Green, always walking on the windward side of the row that the fine particles floating in the air may be carried from you. Stand erect, holding the bottle at arm's length, just above the vines, shake gently, walk rapidly, and the work is accomplished. The vines are not injured in the least unless too much of the powder is applied, nor are the tubers affected. Persons who make use of the Green should remember that it is poison, and "sure death" to whoever handles it without necessary care.

Food for Fish.

Mr. Wesley Horton, Rensselaer county, N. Y., having water which he is stocking with trout, would be advised regarding "the artificial food best suited to the wants of the speckled beauties in the various stages of their development."

Mr. A. B. Crandell.—It is known that trout are far from being vegetarian in their tastes, and that from the first they refuse all supplies not of an animal nature or origin. Though the yolk of an egg boiled hard and grated is said to answer a very good purpose, it is the experience of some of the best breeders that there is nothing equal to loppered milk or bonny-clabber. Three or four table-spoonsful of this is believed to be sufficient for a meal for 100,000 in the early stages. During their first three months the fish should be fed say four times a day, and three after until a year old; though there will be a natural increase of appetite, and the quantity required will be greater, the supplies need not come so frequently. Raw meat may be introduced about this time ("plucks" are most used because least expensive), and it should be chopped very fine. Agassiz says the intestines of sheep or other animals will be welcome, and he speaks a word of warning against overfeeding, so as to foul the bottom of the stream or pond. It is the practice in certain foreign countries (which are not named for the sake of the stomach of prospective fish-loving tourists), to buy up dead dogs and horses, and make them into pies or pates as food for the finny tribe. In other places abroad the still cheaper and nastier custom prevails, of feeding maggots, and "maggot factories" are neither infrequent nor unprofitable. The natural food of the trout is such insects or worms or flies as abound in or near the water, and any grasshoppers or caterpillars or kindred things which light upon the surface or are shaken down by the wind from contiguous trees or shrubs are eagerly gobbled up. There are enough of these abroad, certainly, worrying the husbandman and doing harm to his harvests, and perhaps in the economy of nature yet to be developed they will be rendered serviceable in the way suggested. Possibly the jack-knife is already sharpening with which the coming Yankee will whittle out the all-enticing trap by the influence of which our worst enemies may become our most helpful allies. In that happy future there will be no more weevils in the wheat, no more mosquitoes in New Jersey, and Dr. Trimble's occupation will be gone, for we shall be fattening our finny armies on the frisky curculio.

THE SUNFLOWER.

Mr. Washington Hills, Brooklyn, N. Y., put in a plea for the sunflower, expressing the opinion that were it rare, and therefore costly, it would be held as a floral treasure instead of being regarded as homely and plebeian. Of course, he alluded to the *Helianthus annus*, which is larger and more generally known than either of the other varieties, as it is also the most valuable. The plant grows with great rapidity, its leaves soon become large enough to serve as covering for young cabbage and tomato sets; they also, whether green or dried, make bating for which cattle and horses evince peculiar fondness. In earlier times they were used to some extent as substitute for tobacco, and were regarded as possessed of medicinal virtues, especially efficient in cases of asthma. The golden blossoms afford excellent pasturage for bees, the florets being remarkably full of honey-making material. The seeds, besides yielding oil of superior quality, make first-class feed for fowls. The stalks answer well as bean-poles (and may be planted near the hill soon after the beans are up); and they have been used in hop-yards for similar purpose with satisfactory results. If cut in autumn and kept dry, the stalks are also valuable as substitute for kindling-wood. Certain tests have established the fact that the sunflower is an absorbent of malaria, consequently a preventive of fevers, and, therefore, peculiarly worthy the attention of all persons so unfortunate as to be living within twenty miles of New York, or in low places farther away. All in all, the "poor people's posy," as the sunflower is sometimes called, deserves high praise and, standing up as it does, keeping its broad, round, domestic, cherry face toward the bright side *always*, it sets an example worth being heeded by old mother Gummage, and others of that ilk, addicted to desponding views. Never shirking duty and never failing to be decent, it must be accounted as far more worthy in its life than most politicians of the period, and a hundred times more useful to the human race than many youngish persons, male and female, who, about these days, are attracting attention in Clinton street, or along Broadway, and who, nine times out of ten, would be certain to turn up their dainty noses at an honest man from the country, a producer and not a parasite, should he happen among them with a sunflower in his button-hole.

To Keep the Bugs Away.

Mr. I. J. Simonson, of New Springfield, Staten Island.—The little fly or worm that plays such havoc with our roses may be destroyed by the use of whale oil soap. After making up the whale oil soap fit for use, by mixing with water, put the top of the plant under the water and let it remain about one minute. When this cannot be done it may be syringed, but it is necessary to give it some two or three applications to effect an entire cure, and care should be taken that every part of the bush gets well saturated with the liquid. Another and successful way I have frequently tried is to cover the bush entirely with a sheet, then take some hot coals upon a shovel and cover with tobacco (stems preferred), and the fumigations of the bush will effectually destroy the worms. Care should be taken not to burn the bush; there is not much danger that the tobacco will injure the bush. Tobacco is the best remedy that the florists have in destroying insects. The little black flea, which infests cabbage plants, is destroyed most easily by placing a coop of young chickens near them. Another way is to go over the bed some two or three times a day and throw fine sand ahead of you; this drives the insects off, and if repeated pretty often they will not get back again to do much damage. Watering in the evening is advisable. I have also used salt with good effect. But the safest plan is to plow up a piece of new ground, cover well with brushwood, blackberry vines, or anything that will burn and easy to obtain; then burn over the ground. The ashes makes a good fertilizer, and in most every case will insure a crop of plants.

Adjourned.

June 14, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

A TRIPLE TEAM.

The chairman called the meeting to order at one o'clock, and introduced business by reading a communication from Mr. E. Dibell, Kingsville, Ohio, who wrote on the subject of harnessing three horses abreast. Make a tri-whipple-tree somewhat longer than a double whipple-tree. If you wish the third horse to do a third of the work, put the staple or hammer-hole one-third of the length from one end. To the short arm attach with a clevis and pin the whipple-trees for two horses, arranged just as for a span worked alone. To the long arm attach the whipple-tree for the third horse. Adjust the length of the traces so that the three shall walk abreast. It is usual to have the whipple-trees as short as the horses can conveniently work in, as one does not care, as Burns would have said, to have a team "an acre broad." The common two-horse lines are reset. Let the outer reins go to the outside of the outer horses, and the inner reins fasten to the middle horse. With a couple of straps fasten the horses together by the bits. Some fasten the straps back to the harness of the middle horse, instead of fastening to its bits. This will make such a team as Apollo never drove. This method has the advantage of arranging them so that each shall be compelled to do its part, and they all be under the control of one driver.

Coal Ashes for Earth Closets.

Mr. A. B. Allen, of the New York agricultural warehouse, 191 Water street, New York, wrote as follows: For upward of thirty years, whenever residing in the country, I have used a rude equivalent for the earth closet, and always carefully saved its fæces by mixing them with some foreign substance, and applied this compost with great benefit to my crops. Various substances have long been in use for the purpose of desiccating and rendering the contents of the commode inodorous, such as plaster of Paris, charcoal dust, pulverized clay, fine dry garden mould, peat, and muck, all of which are thoroughly effectual. But as the annual cost of any one of these is considerable, and oftentimes inconvenient to be obtained, particularly in large towns and cities, I would suggest the use in these places of sifted anthracite coal ashes. I have used these in the earth closet I obtained of the Hartford company about a year since, and find that they answer the desired purpose sufficiently well to warrant my continuation of them. Most of the houses of populous villages and cities throughout the United States abound with coal ashes, and in the latter, especially, are only got rid of at something of an expense to transport them from the premises. Now, if we would take the very small trouble of applying our coal ashes to the droppings of the earth closet, we should be quit at once of an inconvenience, and by means of these form a valuable inodorous fertilizer, which, so far from costing a considerable sum annually to get rid of in its separate elements, could be sold for a good price, and thus add to the income instead of the out-go of the householder. The careful saving and use of this rich fertilizer to our growing crops would add largely to the national wealth, purify our premises, and greatly lessen diseases, particularly the much dreaded and often fatal typhoid fever, which seems alarmingly on the increase lately throughout the land. Surely the earnest consideration of this very important subject should be brought home to all. Indeed, it ought to be a matter of municipal regulation. No householder should be permitted to have unclean premises any more than he should be allowed to harbor the plague, or any other dire and loathsome disease. Mr. Reade, in his admirable essay, read on the 24th instant before the club, went into a calculation of the value of human solid and liquid excrements, which, astounding as was the sum figured up, yet I think was much to low. Permit me, therefore, in closing this communication, to add something on this subject from that eminent agriculturist and chemist and profound writer, the late M. Bousingault, of France, whose authority is of the highest order. His average estimate from each adult is 618 pounds solid and liquid excrements per annum, containing eighteen pounds of nitrogen, a quantity sufficient to grow 886 pounds of wheat (equivalent say to fourteen and three-fourths bushels.) Now suppose we set down the 40,000,000 of men, women and children, which are now supposed to be in the United States and territories, equivalent to 20,000,000 of men. Suppose all the nitrogen which could be obtained from this source applied to the wheat crop, the product would be 295,000,000 bushels, worth at the present low average price of the country at least $300,000,000! Is this not a result worthy our earnest endeavors to obtain, to say nothing of getting rid of a loathsome nuisance on our premises, and the origin of many a fatal disease?

AN EARTH-CLOSET APPLIANCE.

Mr. De Witt Stevens, Newark, N. J., showed in this connection the model of an earth-closet appliance, and spoke of it substantially as follows: To effect a change in the present wasteful and miasmatic mode of dealing with night-soil, the means to be universally adopted must be of the simplest and cheapest kind. Such is the character of this apparatus, which can be sold at the low price of two or three dollars. An inclined screen sifts coal-ashes (or earth when sufficient ashes are not available) into the vault. The screen reversed throws the coal back in the scuttle. The screen being inclosed the dust is confined. The operation is quick and effective. As ashes require sifting daily, not more than one day's deposits remain uncovered in the vault. Affixed to a barrel-cover it forms a family ash-sifter, of which the judges at American Institute fair say: The best we have seen. Instantaneous in operation, preventing dust from escaping, cheap and very useful.

PEACHBLOW POTATOES.

Mr. F. B. Kauffman, Bridgeton, N. J., wrote in praise of the peachblow. It is the best potato he has had experience with, though he is not ignorant of the new-fangled varieties. Has never raised less than 100 bushels per acre in worst seasons, generally not less than 200. Last season, for sake of experiment, he turned under orchard grass, applied 200 pounds of guano, putting it in every third furrow, and June 16, three weeks later than common planting time in his vicinity, he put the seed in the ground. The frost came before the vines were ripe; nevertheless, he had from one-eighth acre, which he had measured, fifty bushels of merchantable potatoes and small ones too numerous to mention. The soil was sandy loam, in tolerable good condition, and plowed deep.

How to be rid of Weevils.

Mr. A. Gray, Westport, Connecticut.—If the correspondent who asked for a remedy for this pest will dig a half bushel of sassafras roots and scatter them about his barn, or put a small quantity in his granary, he will find the weevils minus in forty-eight hours at farthest. I remember, when a boy, my father used, in harvesting his rye, to cut and scatter in the mow green sassafras twigs and leaves. In 1820 I was in North Carolina, in the month of May. The merchant in whose employ I was had a large quantity of corn in his warehouse, and the weevil was making destructive work with it. At my suggestion he sent a negro into the country and got a quantity of sassafras roots, and threw them among the corn; in three days after, the outside of the warehouse was literally black with weevils.

Complaint of Crows.

Mr. John Miller, Slackwater, Pa., stated that he had listened patiently to the praises of the Plymouth pastor, Mr. President Ely, and others, but is "at a loss to see where the credit comes in." Crows have killed his chickens; the same "imps of darkness" have stolen from his orchard, not the caterpillars, but the young turkeys that chanced to forage there. Has Henry Ward ever had the nests of his favorite insectiverous birds destroyed, including bobolink, robin-red-breast, goldfinch, oriole? Has Mr. Beecher ever had the eyes of Chester county pigs, that happened to be dropped in the orchard, picked out? We had. Or has he ever had three or four acres of corn, that would yield sixty bushels shelled to the acre, wholly destroyed in one field? Has he ever had his private (house and market) patches picked out, root and branch? If Mr. Beecher has suffered such depredations, and yet can defend these cowardly sneaks, compared to which hawks, owls and foxes are gentlemen, his heart is larger and warmer than mine. It is not my purpose to raise a war of extermination on any feathered tribe; but, so far as the crows and blackbirds in the southern part of our county are concerned, my "say" is said in a very few words: "Make ready, take aim, fire."

The Chairman.—Into the air, I hope, for I feel that this must be an exceptional case, if true, and that the writer's animosity has led him to magnify the evil deeds of our colored friends, while at the same time he has become for the most part blinded to their better nature and practices.

Mr. F. D. Curtis.—There is no doubt that, if the charge is half true, it is exceptional. We know there are times when crows hold council and gather in great numbers. It is possible that, at such seasons, when forage is scarce, they make such attacks as are alluded to, though I am disposed to doubt it. If so, however, effort should be made to baffle them; they should even be fed. But, as a general rule, I believe the crows are the allies of the agriculturist, and I stand up for them now and always. I crow for the crows. By the way, this subject reminds me that, when I was riding past a neighbor's house the other morning, I saw what I supposed was himself in a tree of ripe cherries. I bowed—very politely—because he is of the same political faith, and has a large number of female relatives whose votes I may like to influence in some happy future; but he made no return of the courtesy, and I repeated the salutation, but still no return. I was a little put out, and didn't know but he might have taken umbrage at something I had said here. Afterward, however, I learned that it was a scare-crow, and that the cleverly-contrived effigy proved effectual in keeping the birds away.

GROWTH OF FOREST TREES.

Mr. E. M. Morrison, Noblesville, Ind.—Near here, on the banks and in the bed of the old canal which was commenced along the White river valley in 1836, but never completed, there is a nice growth of young forest timber, and as its age is well limited by this date, it may be of interest to you to know the measurements. These I have taken two feet above the ground. The average circumference of each variety is given: Twenty sycamore, four feet six and one-fourth inches; eight cotton wood, five feet, three and five-eighth inches; eight crab apple, one foot eight and one-half inches; two wild cherry, two feet eleven and one-half inches; seven honey locust, three feet three and one-seventh inches; five red elm, two feet nine and one-fifth inches; eight water elm, three feet five and five-eighth inches; four sugar maple, two feet nine and one-fourth inches; seven black hickory, two feet eight and one-seventh inches; one mulberry measures two feet one inch: one black walnut, two feet nine inches; one hackberry measures four feet five inches; one burr oak measures two feet five inches; one white oak measures two feet ten inches. The black walnut is a nice tree shaded by other timber, but is long enough for two rail cuts. It cannot be taken as a fair sample, however, as it is too small. It will be seen from the above that it would not take long to grow a respectable forest in our rich valleys of the west, and as the timber is so much needed, on the prairies especially, the subject should receive attention. The beef supply is falling off at a fearful rate, but that of timber is leading it, and will soon be a serious question, and the only remedy will be in artificial production to meet the demand.

Mr. Ely.—The statement is valuable as showing the comparative rapidity of growth of the various varieties.

Mr. Curtis.—I wish every farmer in the land could hear and would heed what I am about to say. Set trees in unsightly places. There is scarcely a farm anywhere but has rocky ledges which might be improved and beautified in this way. Few realize how short a time it takes for timber to attain considerable size. Trees afford shade for stock, and are soon valuable for building purposes or for fuel. I set some locusts on slate ledges only a few years ago, and though some have suffered by attacks of the borer, many are now thrifty and as large around as my body, or, at least, as large as it used to be. I should like to show them to any doubting Thomas, and I would also be glad if unbelievers could ride, some July day, along a certain road in Saratoga county, by the side of which, in my boyhood, assisted by a younger brother, I set a dozen sugar maples. They are attractive, and make the farm fully $500 more valuable. They were dug and set by two boys, the oldest not seventeen, in less than half a day, and the fact is cited to show how little time or labor is required. It is not generally known, I think, that the Legislature of this State has passed a law providing not only for the protection of roadside trees, but making it an object for proprietors to thus adorn their property. If I remember correctly, there is an abatement from the road tax of twenty-five cents for each and every tree thus planted along the highway.

Hay and the Hay Crop.

This being the special subject for the day, Mr. J. B. Lyman read the following paper: Economically considered, we have no crop so important as grass. It is the only great crop that can be taken from the ground in an immature state, that is, before the vigor of the plant is spent upon the seed. This gives the grass farmer a great advantage over the grain farmer and the southern planter; for grass lands never wash, and the strength of the soil is not drawn out by the maturity of the plants. We urge upon the farmers of the grass belt of the United States the wisdom of using to the full the advantage which grass gives them. This they can do, first, by early cutting. Nature has exactly fitted the cow and the bullock for consuming grass rather than grain. They have the apparatus of stomachs for converting grass into milk and into flesh. If grass, by which I mean timothy, clover and herd grass, *in bloom*, is made into hay, it forms the best possible winter food for ruminating animals. These views have been gaining ground for thirty years. John Johnston told me that in 1824–'29, when he settled on Seneca Lake, timothy was allowed to stand till most of the seed rattled out, and more of this dead ripe grass was cut in August than any other month. Now, thousands of tons of the best hay we have is cut and mowed away in the month of June. Second, rapid handling gives the modern haymakers a great advantage. In the days when a scythe, a rake and a hand-fork were the only hay-making tools, it was very seldom that grass could be made into hay between sunrise and sunset. Now the mower can have his work done by nine o'clock; the tedder then sets in, and if the day is bright and the wind dry, the hay may be nearly made by two o'clock. The horse-rake now comes in and makes ready for the cart, which is busy till nightfall.

IMPROVEMENTS IN THE SYSTEM.

The houses for storing hay are generally too remote from the meadows, and too much time is consumed on the road and in lifting hay to high mows or pitching it into deep bays. The most thrifty grass farmers have several barns or barracks so situated that short trips will take the hay under shelter. Hay-forks are so extensively used that four-fifths of the crop are lifted by them instead of the hand-forks. Few farmers reflect how much more important one hour in the afternoon of a sunny day in July is to them than whole days in January and February. Precious hours are wasted in careful loading and slow hauling over long roads. In this way hundreds of thousands of tons are spoiled by bad weather or left till dead ripe and nearly worthless. By what artificial system of drying can we manage the crop when clouds and rain invade the month of July, and the golden days for perfect sun-dried hay are passing? As yet no device has been presented to the American public. When it is it will be a question of relative cost, it will be a measuring of so many pounds of coal or cords of wood against so many tons of hay. As yet farmers are not duly impressed with the importance of converting grass into hay. They believe it will be about as well to wait till the ripeness, or, to speak more correctly, the deadness of the grass leaves but little for the sun to do. Until this error has quite passed away from the general mind, the application of coal or wood heat to hay-making will not be general. It is, however, from this direction that we are looking for a true advance in the most important rural interest of this country, not from the use of lime or of salt, or from the packing of grass in air-tight boxes.

Another point in which farmers can make a great advance is in the better distribution of fertilizers. I presume I describe 10,000 mow lots when I describe my father's where I first turned out the swaths and learned to rake. It sloped to the east, lay on the lower side of the road, and received the wash of the house and barn. About two acres in the corner, when the red water from the yard ran over it, was so rich that it would yield two and a-half tons to the acre by the first of July. It was not cut till about the 7th or 10th, and by that time it was lodged and the bottoms of the stalks were blanched and often yellow with the beginning of wet rot. Then ten acres of the lot that lay north of this over-manured patch produced plenty of brakes and ox-eye daisies, and but little grass, so little that it would hardly pay to cut it, and we raked in the thin swath without even stirring out. Lower down the hill there were swales grown up with sweet flag, having clumps of willow and stumps grown over with poison vine, some places mossy, and others yielding a rank growth of sharp-edged water-grass. So between what was too rich and what was too wet, knolls that would always winter-kill, and stony hillsides, that forty-acre meadow gave us about fifteen tons of good hay, and twenty tons of brake and willow and daisy and water-grass. So my father worked hard but was afraid to have winter come, and died in debt. Yet proper management would have made that forty-acre lot good for eighty tons a year of good sweet timothy hay, and my father could have wintered thirty head of neat cattle better than he did twelve. His grand error as a farmer was in not cutting more grass and better grass from those forty acres.

Mr. H. L. Reade gave his ideas on the timely topics as follows: The natural food of the three principal classes of domesticated animals, horses, cattle and sheep, is grass, not hay or grain. When, therefore, civilization removes them from a state of nature, the artificial life to which they are introduced should be as near the natural one as possible. Six months in the year our horses, cattle, and sheep (in the country) live on their natural food. In providing for the other six, we should prepare for them something as nearly like their summer diet as possible. It should not, therefore, be matured stalks dried, but preserved grass. All grasses reach their highest point of excellence, considered as food, when they first come into blossom. The vital elements are then scattered throughout the entire plant, which in no part has suffered the exhaustion and loss attending the complete or even partial development of the seed. Grass, then, should be cut when the blossoms first open. Practically, if the grass on any given farm is mainly of one variety, it is better to begin cutting before it reaches even this state of maturity. Timothy and red top head about the same time. If we wait for the appearance of the blossoms before we begin, we shall have the matured seed and the weedy and almost worthless stalk before the end is reached. In the matter of clover, if it stands erect, it is safe to wait till one-half the blossoms begin to turn, never later. The other half will be so perfected in growth that there will be no less in quantity or quality. If lodged it should be cut much earlier, as the decay at the root will more than counterbalance any growth elsewhere. In regard to grasses not specified, the same general rule will apply, bearing in mind that it is always better to cut considerable before it reaches perfect maturity rather than considerable afterward. Next and most important: How shall this grass be cured so that it can be packed in bulk and be kept without injury until such time as it is needed for food, and yet retain most of its nutritive properties? The best way, as it seems to me, is this: If there is reasonable promise of a fair day the mowing machine should be started at five o'clock the night before, and again as soon as the dew is off in the morning. By eleven, all the grass that can be handled will be cut. Then, transfer at once the horses from the machine to the tedder, and go over the field once before dinner. At one o'clock, start the tedder a second time. At two, attach one of the span to the horse rake, and by four o'clock, the hay cut in the morning should have been pitched (not rolled) into tall, well-trimmed cocks, containing from eighty to one hundred pounds each. Let these stand until the first fair day following, and then open and turn as is needed, until ready for the barn, which, under ordinary circumstances, will not require more than an hour from the moment it is evenly shaken out to the time that the transfer should be made to the load and from thence to the mow. It will thus be cured evenly, every portion getting nearly the same amount of sun. The juices will not be baked out of it, but dried in it, and most of the natural flavor, sweetness, instead of being exhaled, will remain to make the mass palatable as well as nutritious. As to clover, I advise the same process, only that instead of opening the cocks the first day, let them stand from three to five, as the weather and circumstances render expedient, always a sufficient length of time to make any exposure to the sun, beyond pitching on to the wagon, at midday altogether needless. In this way nearly all the nutriment as well as bulk that the clover had when it was cut finds its way to the barn; but if "shook out" two or three times, most of the leaves are left in the field, and the stalks are rendered unsavory as well as comparatively worthless by the combined action of the sun and dew. Generally speaking, I think that farmers err on the side of over rather than under drying. Grass cut when perfectly free from dew, and getting a thorough and even wilt the first day, and then cooking over night, if the weather is all the time favorable, does not need much sun the second time it is exposed; in fact, if the air is hot and dry, the less (usually) the better. The suggestions made with regard to the mode of drying apply to these meadows when the yield is a ton and a half or more to the acre. Where the grass is thin, and the tedder not needed, I would advise that the hay be raked earlier in the afternoon and put into cocks, to stand over night, even though the first day's sun might fit it for the mow. Much of the must in hay comes of making the transfer from the field to the barn, when the air is charged with moisture, as in cloudy days and near nightfall. "Cleaning up," therefore, each day, has its unfavorable as well as favorable side, and, as it seems to me, is not to be ordinarily commended, especially when the farmer has a supply of cloth hay-caps, which are eminently worthy a place in every hay field. In conclusion, I urge the observance of the following rules: First. Cut the grass as it is coming into blossom, earlier rather than later. Second. Cut it when it is as free as may be from any moisture except its own juices. Third. Have special care not to overdry, and be particular to dry evenly. Fourth. Make the transfer of the hay from the field to the barn at or near the middle of the day, and when the air is dry and hot.

Dr. J. V. C. Smith.—While I admire the learning of the eloquent essayist, I would hear from the man who can tell how to dispense with hay. There is not a mowing field in all Turkey, neither in all Greece, and yet in these countries we find the best horses in the world, fleet, powerful, with large endurance; and they live on condensed food, getting something bulky to give the stimulus of distension. We must do likewise; lessen the area devoted to grass and grow more cereals; for the time is coming when the whole land will be required to supply food for man. Unconsiously we are advancing to this system.

The Chairman.—Does our medical friend forget the sweet fields beyond the flood, all dressed in living green? And must we give up these for the sake of Bucephalus and horses of less degree?

Dr. Isaac P. Trimble.—We may, when the time comes, economize the upland by draining the swamps and redeeming the marshes. In Salem, the best county in the best country, 15,000 acres having been rescued from the troubled sea, and now yield, year after year, to the end of time, thousands of tons of hay, than which there is none grown at less cost.

Dr. E. Ware Sylvester.—It has been my practice for several years to cut grass when the seed is in milk, and I am satisfied I thus secure the largest amount of nutriment. As regards curing, it may be best to use a tedder and put in mow the same day; but my way is to cut in the morning, put in cocks, next morning turn the cocks, and get the hay into the barn before night.

Mr. F. D. Curtis.—No general rule can be laid down for cutting hay, as bad weather and a long harvest make a difference. More hay spoils by being left to get too ripe than by cutting too green; hence it is always safe to begin early, when the blossoms first show themselves. It is a mistake that the seed in hay adds to its nutrition, for this goes into the manure heap undigested, and is lost. Farmers should get ready beforehand. Our essayists, Messrs. Reade and Lyman, talk about the quick and efficient work of the hay tedder, when the truth is, not one farmer in a thousand has any tedder but a pitchfork. Dr. Smith seems to be in favor of progressing backward. Hay is an advanced idea, and grass is everything. It is the greatest and most important crop in this country. Grass enriches the soil, and is the mainstay of our flocks and herds through the long winters; hence it ought to be preserved in the best manner, and when in the most succulent condition. The instructions we have heard to-day are so good that they should be enforced, "line upon line, precept upon precept, here a little and there a little."

PROFIT IN TURNIPS.

Mr. Alexander Palmer, Modena, N. Y.—The proverbial slowness of the farmer to adopt new ideas is illustrated not more by his apparent neglect to supply his family, at a small cost, with a succession of choice fruits, than by his neglect to supply his cattle and horses with such succulents as are so necessary for their health and thrifty growth. It is not generally known that, for the table and making milk and beef, there is no root crop equal in value to the long, white French turnip; this gets confused in the market with the common white turnip, which has no value either for the table or for stock; hence, dealers are cautious about giving it to their customers. It being so hardy and productive, and contains such a large amount of saccharine matter, that it deserves to be placed first upon the list, and will doubtless soon become the standard, not only among our market gardeners, but will be grown largely by our dairy and beef farmers. It can be planted any time from the 15th of June until the 15th of July—the earlier the better. After plowing and pulverizing the soil thoroughly, it is my practice to mark the ground with deep furrows, two and a half feet apart, in which I spread the manure; and I form the drills by turning two furrows over the manure, level the top of the drills with an iron rake, and sow, with a hand drill, one pound of seed to the acre, thin out to ten inches in the row, and, by a thorough culture and a liberal supply of the phosphates, a yield may be expected of from 500 to 800 bushels to the acre of turnips that would not only grace the table of a prince, but would fill the pail or fatten the ox of the humblest farmer.

DRIED BERRIES.

Mr. L. A. More, Albemarle Co., Va.—With us, blackberries are so plenty that they cost from two and a half to three cents a quart, delivered at the door. Can they be dried with profit, and, if so, how?

Mr. J. B. Lyman.—There is a drying chamber, where twenty-five pounds of coal will keep the room at the temperature of 160° to 180° for a day. You can get twenty-five cents for dried berries that, green, cost you twelve. The drying-chamber and stove can be made for twenty-five dollars, and will serve for drying clothes.

BOOKS ON FLOWERS, FRUITS AND VEGETABLES.

Mr. Hiram P. Miller, Greencastle, Ind.—Will the Farmers' Club be so good as to inform me what is the best work treating of the various branches of horticulture, or of works treating of its special branches?

Mrs. Laura E. Lyman. — Let him begin with Peter Henderson on Practical Floriculture. I find him excellent. I find he tells you what to do and how to do it. He gives the ways and the processes in a style so simple that the wayfaring man, though a fool, need not err therein. When he has graduated on Henderson, let him read Parsons on the Rose. If he wants to know of small fruits, let him buy Fuller. Quinn will tell him all about pears, Warder all about apples, and Henderson, in Gardening for Profit, all about lettuce, celery, cabbages, and other garden vegetables.

SULPHURIC ACID IN FARMING.

Mr. John J. Carter, Collamer, Chester county, Penn. — Will your chemist consider whether it would materially enhance the value of unprepared fish guano, such as sells from twenty dollars to twenty-five dollars per ton, if it were treated with sulphuric acid, as we do bones? Experience has shown us that a slight addition of acid to bone, only enough to dissolve a small portion, makes a wonderful difference in its action, especially if applied fresh to our land; more difference, I think, than can be accounted for by the usual theory. One of the most popular phosphates in our market (More Phillips) is composed of coral reef rocks (or something that looks exceedingly like it), ground and treated with acid. This rock looks very unlike a fertilizer, yet the phosphate made from it acts quickly and efficiently. When we consider that, in this county alone, $200,000 worth of commercial fertilizers have been used the past season, questions touching their value and improvement become important to us.

Prof. J. A. Whitney.—Sulphuric acid is about the only available solvent for bones and similar phosphatic materials. When enough is used, it will liberate all the phosphoric acid from bones, and a less quantity will convert insoluble phosphate into soluble superphosphate. With lime compounds, its action produces sulphate of lime or plaster. Dilute sulphuric acid may be used to fix the ammonia of fermenting manures and fish guano; but in practice, the use of fine, dry muck or even loam is preferable.

WOOD ASHES AS MANURE.

Mr. A. R. Brown, E. Kingston, N. H.—I am a farmer, and feel interested in the subject of manures. Our land is naturally heavy, clayey soil and gravelly loam. The original wood growth was beech, maple, elm and hemlock. I have lately used large quantities of leached ashes, but they cost us here twenty-five cents per bushel. The various phosphates are too expensive. Can you enlighten me as to the chemistry of soils? Can I not in some way enrich my lands cheaper than to pay so much for ashes, by the mixing of soils; also, can you inform me whether by long usage of leached ashes the soil is injured; also, what is the comparative value of dry wood ashes and the same leached?

Mr. J. B. Lyman.—Every good manure that will of itself make crop after crop without wearing the land has three or more ingredients, lime, potash and phosphoric acid. Ashes contain lime and potash, especially oak and other hard wood ash. But leaching takes out much of the potash, and leaves the lime. Horace Greeley is sure that he can afford to pay fifty cents a bushel for leached ashes, but not more. I doubt whether there is profit in leached ashes at fifty cents. He is right in saying that he cannot afford to buy phosphates as they are commonly sold. The true way for Mr. Brown and 10,000 other farmers in New England to build up their farms, is by a stricter saving of all manures, and by buying fat food for his cows and sheep. By fat food I mean flax-seed cake and cotton-seed cake and corn meal. First, he must look after the bottoms of his stables and yards, to see that they will hold urine. Then he must set in, after haying, to digging and hauling black swamp muck, ten loads to every horse and each head of neat cattle, and three or four loads to each hog, with a liberal allowance for sheep. He must use enough to absorb all the water, and it should be often mixed with the droppings. Then he must feed high, with plenty of strong, rich food. If he buys manure, it should be either bone-meal or real guano, beside the ashes. But if he keeps stock enough, and uses muck enough, he will not want phosphates. Land dressed with good, strong yard manure stays manured, as a house stays painted or a field well fenced stays fenced. But dosing land with pinches of strange-smelling stuff is like feeding a horse. He will be just as hungry to-morrow as though he had not eaten his peck of oats to-day.

AN IMPROVED PLOW.

Mr. D. W. Pendleton, Branchtown, Pa.—I hear of an implement called "Godfrey's Revolving Mold Board Plow." As everything new of this kind deserves attention, and as much is claimed in the leaflet I have received from the manufacturer in respect to its efficiency both in sod and fallow land, I desire to inquire what is known of its merits. Does it pulverize the soil in the manner alleged? Does it work well in sod? Does it run steadily, so as not to distress the plowman or team? What is the peculiarity of the so-called "revolving mold board?"

Mr. J. B. Lyman.—I went up to the farm of Col. Weld the other day, and saw him try this plow. There is a steel disc, eighteen inches across, and shaped like a tea saucer, in place of the usual curved mold board. The furrow comes up in the usual way, and strikes the lower edge of this disc. The push causes it to go around on an axle, and this lifts the dirt and throws it out some distance from the plow. In soft ground, and with a brisk stepping team, the dirt rolls off in a stream and all the ridges are covered, so the field looks as though it had been harrowed and bushed. It is decidedly the best pulverizer of earth there is, and it turns sod well. As a one-horse plow for laying by crops, it is likely to be a great favorite, as it throws the dirt all in between the stalks without taking up earth enough to interfere with the roots. It turns sod well, but not equal to Collins' steel plow. By taking the rub off the mold board and shifting it to the axle of the revolving disc, I am satisfied that considerable drawing power is saved. The inventor thinks a third, but I doubt it. It should be carefully tested by a dynamometer. The plow I saw ran quite easy, but had more than enough iron in it.

Adjourned.

June 21, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

DOUBLE CROPPING IN ORCHARDS.

A communication was read from Mr. D. S. Baker, Allen, Pennsylvania, stating that a neighbor of his has an apple orchard which is prematurely decayed. The trees were planted some nine years since. Last season the symptoms of failure became more marked. The land between the rows has been devoted to root crops, and is now seeded to wheat and clover. What shall be done?

Dr. Isaac P. Trimble.—Too much is expected. To demand double crops is unjust. Dr. Ward, of Newark, who used to come here, and whose absence of late years is our loss, pursues a wiser practice. He plows each spring some three inches, applies a coating of manure, and then dresses with mulch from salt marshes. In autumn he places this in cocks, where it remains until after it is again plowed and manured in spring. The consequence is, there are no weeds, and such crops of pears are seldom seen. Of course it may answer to devote some space to minor crops while the trees are small.

Mr. Frank D. Curtis.—I question if farmers generally can afford to pursue the course our friend recommends. We can get double crops if the application of manure is sufficiently liberal; but, of course, we will fail if such application is withheld. In the absence of salt hay for mulch, which is unavailable for most orchardists, there must be more frequent and thorough cultivation to keep down weeds.

Mr. H. L. Reade.—I think it is the general testimony of every one that we get the best fruit from trees growing in our gardens, where other crops are cultivated each year. To be sure, the land is generally kept mellow and well manured.

Mr. J. B. Lyman.—The best pear grower in New Jersey, Mr. Quinn, plants trees in rows sixteen feet apart. While they are growing, and before they yield, he crops nearly the whole surface, raising with them such exhausting crops as rhubarb, cabbages and lettuces, and manuring liberally every year. As they attain greater size, he mulches with salt grass for four feet each side. This leaves half, or a strip between the rows eight feet wide, where he sometimes plants currants, but more often egg-plants, potatoes, tomatoes or lettuce. As the trees become more and more profitable he gives up all the surface to them, but does not cease to require some service of the soil of his orchard till the roots occupy all the earth and the branches shade the surface. But he fertilizes with a free hand as long as he thus exacts double duty.

STRAWBERRIES FOR THE MILLION.

Mr. Henry T. Williams read the following paper:

No village garden or farmer's home grounds are now considered complete without the delicious strawberry. It brings health to many an enfeebled frame, quickens the physical energies, stays the hands of merciless disease or death, fills the household with delight, adds pleasure to the city lover, while to hundreds of anxious cultivators it proves often a God-send in their efforts for a livelihood. Let us look for a few moments at some simple, practical facts in their cultivation and management.

Soil.—Almost any good garden soil will grow strawberries; but it must be well drained, warm, and not overrun with weeds or grass. A cold or wet situation will surely cause failure. It is useless to expect large crops of berries on light lands. In all soils deficient in vegetable matter, the strawberry will never attain a rank, permanent growth. A shovelful of manure must be applied to every hill, which will support the plant for one or two seasons, after which other stimulants must be given to keep it up. On such poor lands, I think it best to grow nothing the first year; simply sow the fields over with clover or buckwheat, then plow it in, and continue the same process for one or two years, by which time the land will have some strength of its own to give to the plants growing upon it. Even then, the manure must not be omitted. On good, strong, heavy or clay lands the strawberry will thrive and produce immense crops. It is on such lands only, that strawberry culture can be really made a steady, profitable occupation.

Manures.—The strawberry is one of the most exhausting crops ever cultivated. Its roots search every available inch of the soil within a foot of the surface, and, unless liberal applications of manure are given yearly, the ground becomes impoverished. Some soils are already in so good heart that no stimulative is needed. Many of Mr. Knox's fine berries have been grown on land five years which has been manured but *once*, and that moderately. But he stirs his land deep and keeps his plants in hills. On the other hand, our friend, Dr. Hexamer, finds it necessary to spread from fifty to one hundred loads of manure per acre every three years and keep it up steadily. The best method of applying manure on strong soils is broadcast the fall before planting on light lands directly in the hill, and in the winter mulch with coarse manure also. Next to barn yard manure, the very best of all applications, but sometimes too full of weeds, or so adulterated by stable-men as to contain but ten per cent of the "simon pure" article and ninety per cent straw and hay seeds, I esteem prepared muck, composed of swamp muck composted with lime and fermented during the hot months of summer or worked over during the frosty days of early winter. Plow a furrow where the plants are to be set, and scatter the muck thickly along the row, then put the plants directly upon the top of it, and it will not fail to take good hold. Next to this is pure bone-meal. For the past two years I have relied on bone meal entirely. Superphosphates are not to be trusted; but the former, selling for ten dollars a ton less, has been worth fully 100 per cent more, and always excellent for all descriptions of fruit. This I apply in quantities of 1,000 pounds to the acre, scattering immediately over the plant just before a rain, or in a moist, cloudy day. The best time of year is about the 1st of August. The plants are then recuperating from the last spring's crops, and forming new fruit sets for the coming spring. The bone-meal supplies an agreeable nutriment without excessive stimulation. Special fertilizers and solutions are sometimes used in gathering.

Liquid manure is always good. A pound of potash dissolved in a barrel of water will cause the plants to throw out an immense number of runners. A pound of sulphate of ammonia, dissolved in a barrel of water, will cause the plants to produce an immense amount of fruit; but has a tendency to cause them to mature very late. In the spring time a light sprinkle of guano, say 300 pounds per acre, broadcast, may prove a great help; but in general I think it always bad policy to force plants forward. There is sure to be a reaction some time, and nothing is so desirable as a good preparation beforehand, and then a steady, onward growth, every part of the plant becoming well matured and able to bear heavy crops without strain. The phosphatic manures are the best fertilizers for all kinds of fruit.

Plants.—A great drawback in successful strawberry culture is in poor plants. I have no doubt the failure of many a cultivator dates back to the time when he preferred to get his plants of a cheap dealer at three or four dollars a thousand rather than from one who had a good reputation and a pride in sending out superior stock, well rooted. In nearly every case this cheap stock proves completely worthless: either the varieties are all mixed, or the plants are small and feeble, or they are thrown carelessly into barrels, without careful packing, and arrive at their destination a conglomerate mass, injured, heated and decaying. Even if the living ones are planted out, they soon die in spite of the most persistent efforts to keep them alive, and at the end of the season those which remain have cost precisely as much as those obtained from a higher priced dealer. I really think good strawberry plants cannot be properly grown to respectable size, dug, handled, packed, and safely shipped, at less than eight dollars per thousand. A thousand good plants, well planted and established, will give the grower, with their runners, a better stock for his bed or plantation than 3,000 obtained at a cheap rate. Every time I have purchased cheap stock I have lost money, and it is well for all beginners to avoid it if they would be successful. They must undertake less work, but do it more thoroughly.

Planting.—In the latitude of New York and northward, the spring is the only favorable season for planting. The plants will have the advantage of the spring rains, get well started, grow finely, and produce a good crop the succeeding spring. Fall planting in this climate is more often a failure, the plants not often living through the winter nor having any crop the next season. But south of here, say below Philadelphia, fall planting is quite successful, and average crops are obtained the next spring. I want to call special attention to two important particulars. 1st. Never heel your strawberry plants nor buy from nurserymen plants that have been heeled over winter. I have always found them a failure. 2d. In packing or unpacking your plants, always keep the roots away from the light of the sun. Select a cloudy or wet day for planting. If possible, just before a rain, or just at nightfall. It is well also to shade the plants a little until they get fairly started. I received once two sets of plants from a dealer. The first were taken up in the spring from the nursery and planted out in the field just before a rain. They have proved a splendid success. The second lot had been heeled during the winter, and were not planted until after the rain. They never did well, and I have plowed them up. The loss to me has been fully $200.

Distances.—Varieties differ greatly in their treatment. Some do best in beds, some in rows, some in hills, some running all over the ground. Some should be plowed under after their first crop, others after the second, but I prefer the following two systems for varieties named hereafter: First. For family use, put in rows two feet apart and plants one foot in the rows making a bed about fifteen feet wide, and from twenty-five to 100 feet long; 100 good strawberry plants will just fill a bed ten by twenty feet, and if well treated will supply a family every day as long as the varieties last. If the bed is extended 100 feet, and filled with early, medium, and late varieties, the family can enjoy a continual feast for two months. The whole need not cost twenty dollars, and never could be money better expended. Second. For market, I prefer to grow in hills eighteen inches apart, and rows two and one-half feet apart. I think it a decided injury to put plants too closely together. Their roots need considerable space to ramble round in, and I am satisfied the more room we give our plants the stronger will be our stools and the greater the productiveness. An acre of plants in hills two feet apart will yield twice as much as one where the plants are a foot apart, manure and cultivation being the same. The Wilson is a variety sure to bear under any sort of treatment, but the Jucunda and Triomphe de Grande, and in general all first-class choice varieties must be grown in hills and kept well trimmed.

Cultivation.—Keep the cultivator stirring every week during the first year. Keep down the weeds and grass or you will lose your berries; clip off the runners constantly. The effect of this practice is wonderful, the plants having now no interference from weeds, nor runners to support, make a fine growth, form large shoots, and are able to mature large quantities of fine berries. Strawberries must not be left to take care of themselves. Every fall, just as the ground freezes, cover the field completely with mulch. This consists simply of salt hay, straw, leaves, or chopped cornstalks. I consider this the most important of all points in the culture of berries. It prevents the plants from being injured by the winter weather, it protects the soil from scorching sun in the time of drouth, it often doubles the crop of fruit by supplying moisture and coolness to the roots of the plants, while it also keeps the fruit from contact with the earth, and assists in rapid ripening and fine coloring. Plantations that are mulched regularly never send any sandy or gritty berries to market. It will pay any man to apply twenty-five dollars to fifty dollars worth for every acre in cultivation. Salt hay is the best, wherever obtainable, and will last two seasons. About ten loads to the acre will be needed. There is another point in fancy strawberry culture not generally known, and perhaps may not be believed. After a hill of berries has borne for one or two seasons it is well to cut off the old leaves and fruit stalks, and permit a new top entirely to form. The effect is sometimes wonderful in the next crop, which is often the finest ever produced. A neighbor, whose patch of Wilsons had borne for three years, and was very full of weeds, looking pretty well "played out," after fruiting time permitted the runners to run freely over the ground, and also the weeds and grass to grow in abundance for two months. Then taking down his scythe, he went into the field and mowed everything from beginning to end. He supposed the plants would die out, and in their place next spring there would be a good patch of grass. To his astonishment, next spring he had the largest and finest berries, as well as the most prodigious crop ever known. This practice is a common one among many English gardeners, whose fruit grounds are celebrated for the beauty, excellence, and productiveness of the fruit. It is a practice we cannot yet recommend here for general trial, until we know a little more about the best time and best manner to do it, but the theory is very plain. It relieves the plant of the incubus of its old leaves and fruit stalks, now nearly exhausted, and while the roots are still in full vigor, it forms new tops and sets for the coming year. It seems to be a very reasonable and proper practice, as much so as the pruning of trees and shrubs.

Profits.—The profits of strawberry culture have been greatly exaggerated. I have no doubt many will support me in the assertion that no branch of rural industry demands so much time, labor, capital, and yet is so uncertain, as fruit culture. Production varies exceedingly. On the light lands south of us the average number of quarts per acre is about 1,000. Very few fields average over 1,500. Prices, too, have been fluctuating and unremunerative. It is likewise impossible to provide for the safe arrival of fruit in market, and every cultivator must expect a good share of losses and disappointments in the course of each season. My field of four acres is well attended to in every respect, yet I lose from $200 to $300 yearly in spoiled fruit. Seasons, too, are often disastrous. A wet season will cause the fruit to be too soft, while a dry season cuts short its size and quantity. Multitudes enter into the business who do not calculate the cost or the chances. I would not like unworthily to disturb the "halo of pleasure and enthusiasm" stimulated by such books as "Ten Acres Enough," and "Gardening for Profit," but I think a little experience now and then will do far more good and yield a more wholesome influence. I believe the people generally would rather have the truth than the fancy of any such promised profits. It costs me $500 per acre to properly get a bed of strawberries into bearing, or $300 exclusive of land. Of this, $100 is capital expended in berry baskets. Still I make my land pay all expenses, interest on cost, and a profit of from $100 to $200 per acre per annum. Our neighbors call us very lucky, for none of them are able to approximate these figures. I believe the average profits in Delaware are not over $150 per acre, while in South Jersey they will run from $100 down to zero, more frequently the latter. I do not believe in strawberries as a farm crop by ordinary farmers. With them it is generally a failure, and it is from such that we experience so disastrous gluts, disturbances and poor fruit in our markets yearly. It is a business fit only for gardeners, who can devote time to a small spot of ground, manure thoroughly, and cultivate well. It certainly cannot be made permanently successful on any other plan. While I have observed the rush into large strawberry farms of twenty acres or upward, yet the natural result after a while is to dwindle down to less than six, or else to be given up entirely. I advise no fruit-grower to depend on one crop alone, but to have a variety, one succeeding the other. Even then I would not depend upon fruit exclusively, but would have a little extra land on which to grow food to support the family, horse and cattle, if his fruit crops should fail. Manure is one of the most important items. He will need immense quantities, and it must be made at home. Every dollar spent off the farm for manure diminishes the profits. To make the business truly successful, every grower must endeavor to secure a home market, as well as a distant one.

Varieties.—After cultivating a large number of old and new varieties, I have thinned my list down to the following: For market—Wilson, Jucunda, Triomphe de Grande, to which I might add for trial, the Barnes Mammoth. All that a market berry needs is good size firm flesh, and deep red color. Flavor is of minor consequence. The Wilson is our main reliance. The Triomphe de Grande pays with fine treatment, heavy soil and good prices. The Jucunda is doing better every year, as Mr. Knox's system becomes better understood. The Fillmore is hardly second to the Jucunda. They must be grown only in hills, and the runners vigorously clipped.

For Family.—In addition to the above, I would select the Green Prolific, Russell's Prolific, Chas. Downing, Boyden No. 30, Napoleon Third, Lady Finger. Among the new varieties, the Nicanor is very early and sweet, but small. The Michigan seedling, late and also sweet, berries of moderate size, very productive. The Napoleon Third does well on heavy soils and is exceedingly fine flavored. The Wilson and Green Prolific never disappoint the planter. The Russell's Prolific is still an excellent family fruit. The Agriculturist and I do not agree. The taste is nauseous and I have given it up.

The future points out a few important points, which we observe will enable us to redeem some of the disappointments of past years. First. We must encourage more than ever the extensive cultivation of strawberries for family use. Thousands of country homes are yet without a plant, and we can never *overdo* the business of inducing many more families to indulge in such simple and lasting enjoyment. Fruits for the family will always pay. Second. Strawberry-growers must locate nearer the markets where the fruit is sold, and devote more attention to *late berries.* The rage for early fruit has carried cultivation so far south into Delaware, Maryland, and Virginia, that we have now here few home-grown berries, and there is a period of two or three weeks before the 1st of July when there is actually a slight scarcity of strawberries. Home-grown fruit, being also more fresh, is also worth a higher price. I believe the time for cheap strawberries has in a measure passed. Delightful as it may be to gratify the desires of those large-hearted philanthrophists who would supply thousands of poor families with an abundance of cheap, delicious fruit; and while I, too, believe in strawberries for the million, still I must not forget that the laborer is worthy of his hire, and more than one anxious cultivator has found to his sorrow that it does not pay to raise strawberries at ten cents per quart.

Dr. F. M. Hexamer, Newcastle, N. Y., then showed twenty-four varieties of this berry, and the chairman, referring to his enterprise and intelligence as a progressive farmer, and the 300 varieties of potato which he cultivates, requested him to state the result of his experience in growing strawberries for market. He indorsed all that Mr. Williams had said, and continued : When I am asked which variety is best, I say plant Wilson to begin with. We sell more plants of this variety than of all others combined. It grows well everywhere, in any sort of soil, in hills or rows; endures neglect well, though good cultivation pays here, as everywhere else. True, the Wilson is very sour, but that is no objection in the eyes of city purchasers, who buy for color and size. The Triomphe de Grande is with us more profitable ; so is the Jucunda ; these sorts selling in New York for about three times as much as the Wilson. We have engaged our entire crop at forty cents net. We have been able to do this because the gentlemen to whom we sell has found our berries well packed. The big ones are not all at the top. It is hard to make a good name in the New York market, but it is harder to keep that name for years; success is such a tempter; but once forfeited, a good name cannot be regained. I am very particular that the quality of my berries shall hold through all the boxes and in every part of each box. Intelligence, good sense and perseverance are just as necessary to make a good grower of strawberries as they are for a builder of railroads. I have spent ten times as much in getting ready to make good strawberries as I supposed I would, but at last the business is on a paying basis.

The Triomphe has hardness, is more solid, dryer, and less liable to be affected by rain than Wilson and most other sorts. It needs more care, and to find out where it succeeds one must make experiment. When one knows that he can raise good Triomphs there is more money in it than in any other variety, but he must get his land in high condition. It has cost me $200 an acre to put my strawberry grounds in prime order. The Jucunda I like less; it is softer, but keeps about as well as Wilson. A good point is that it continues large to the end of the season. Early varieties we do not raise except for local market. First in the list of these I class Brooklyn Scarlet. Purr's Pine is a little later but more prolific; softer, but grows everywhere. French Seedling is hardy, but has a disagreeable taste. The most prolific early variety is the Downer. Nicanor is first-class, and comes just before the Wilson. The Ida, another early variety, I do not recommend. Lady of the Lake changes its color, like the Wilson, after being picked a day or so. Barnes's Mammoth is not very good, according to my experience, the present season. Boyden's No. 30 has a long soft neck which makes it unfit for a market berry, but is superior in most respects to the Agriculturist. For drying and preserving there is nothing better than the Lady Finger. This is very late. The Green Prolific is even later, but very soft, and liable to be injured by rain. Lenning's White is the highest flavored of any, and if it were a little more prolific there would be nothing better for home use. The meanest and poorest of all the sorts is Colfax, which was sent out last year with sound of trumpets. I invested twenty dollars, and would sell now for twenty cents. This shows that it costs something to test the new varieties which are offered from time to time.

Mr. H. L. Reade.—One of the best suggestions made here to-day is that men all over the country go for the culture of strawberries for a home market. I live near a village of two thousand inhabitants. They use now, perhaps, 1,000 quarts a year, and they would use three times as many if they could get them. They pay an average of twenty-five cents a quart; and as those that raise them market them with moderate cost, the profit is large.

The berries are now supplied mainly by one man, who makes a handsome income.

Ashes on Corn.

Mr. Charles Carlisle, Woodstock, Vt.—I put a shovelful of rotten manure and a handful of wood ashes in the hills of corn with satisfactory results. Last year I left fifty hills without ashing, and harvested from them eighteen pounds of dry corn ; from fifty hills when I put ashes and manure in the hill I harvested twenty-eight pounds. If we call 4,000 hills to the acre, and fifty-eight pounds the bushel, we would get nearly thirty-nine bushels to the acre where ashes and manure were used in the hill, and twenty-five bushels where manure only was used, leaving us fourteen bushels of corn in favor of the mix, and to pay for using about the same number of bushels of ashes. Is it not possible that the corn is benefited by the mixing if we cover with the mellow soil to receive the liberated ammonia?

Woodpeckers and Crows.

Mr. Charles T. Paine, Randolph, Vt.—Some time ago the Club invited letters from those who could give information in relation to birds committing depredations on fruit trees. I see it stated more recently that woodpeckers in no case pecked into sound trees, but always into unsound ones for borer, etc. Now I have been quite an observer of birds and their habits, and can name them all by hearing but a chirp or a bit of a song. There is one species of woodpecker called the yellow-bellied (*picus varius*), that arrives here about the 10th of April, and has the habit of pecking into solid wood. I am a farmer, and make maple-sugar in the spring, and I have seen this woodpecker peck a row of holes through bark into the solid green wood. These holes are on one side of the tree horizontally, and the maple sap runs freely from them, causing a considerable loss of sap. In my orchard is a fine red Astrachan apple tree badly damaged by these holes. A number of other trees have been nearly spoiled in the same manner. These are facts, and facts are called for. Woodpeckers are quite plenty here; and I am glad of it, for, though they do some damage, I have no doubt but the good they do the farmers far outbalances the evil. I wish I could say as much for the crow. He is a thief and a robber. Mr. Greeley declares the boy who robs a bird's nest is robbing the farmer of part of his crops. This is true; but he would spare the crow, the greatest destroyer of birds' nests in our midst. I have spent considerable time in collecting birds' nests for years past, and have satisfied myself that over half the birds' nests that are built in the woods and fields are destroyed by crows. They even come into our shade trees and destroy the nests of the oriole, robin, and others. The food of the crow is principally frogs, young birds and eggs, grain, grasshoppers, grubs, etc. I think we should have far more insect-eating birds.

Mr. A. A. Hilliard, Brighton, Ill.—I am a member of the Illinois State Horticultural Society, also of Alton Horticultural Society, which, I believe, has the reputation of being the most live institution of the kind in the Union. Some of the members of your Club have indulged in some pretty severe strictures on the course of the Alton society on the bird question. Our State society resolved to shoot three or four of the worst kind, the oriole, cat-bird, bluejay and red-headed woodpecker. The Alton society followed suit. We love the birds as well as any one else; that is, the civilized ones, the robins, larks and blue-birds. We encourage them to build their nests, and are even importing English sparrows to catch insects. We care not for all the fruit they can eat or carry off to their young. But those we call the Ku-Klux-Klan birds we have no sentimental sympathy for. They do not eat or carry off grapes, but peck their wicked little bills into them and spoil them, just out of mere wantonness. True, the oriole is a beautiful bird, but a greater rascal never lived. Dr. Hill, our State horticulturist, who is a persevering man and paid for his time, studies deep into these matters. I understand him to say that no bird or fowl can possibly be induced to eat an insect of the curculio family. If that is so, then a large portion of your bird glorification vanishes into thin air, for that is about the only formidable enemy we have to contend with. We don't employ boys to shoot birds in our vineyards so much to kill them as to scare the myriads of them away; though they do, by accident or otherwise, sometimes kill a few bushels of them of a morning. I suppose we have fifty birds and 100 insects here where you have one at the east. I wish some of our tender-hearted eastern horticultural friends would come out to Illinois and raise a fine crop of Delaware grapes. If it don't take all the bird poetry out of them, I'll give it up.

Inventions.

Mr. J. B. Corbin, Whitney's Point, Broome county, N. Y., has brought out a butter-worker that looks better in the model than all the old ones. Any round wooden bowl may be used. A worker on a level is set above it, and the stand on which it is placed tilts in a convenient way to allow the buttermilk to pour off. It works exactly on the hand-ladle principle.

A visitor from Fishkill Landing brought a full-sized model of a cast iron picket fence post that deserves examination. The rails enter sockets cast for them, and the fence goes together without nails. The post is in the form of an inverted Y, thus, ⅄, the braces being rammed tight and held down with stones or bolted to a sill. The post can be cast for four and one-half cents a pound, and weighs twenty pounds. A smaller and shorter post of that fashion, suitable for wire, can be made for sixty cents. He puts up a handsome and durable fence in this fashion for fifty cents the running foot.

Adjourned.

June 28, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Mammoth Watermelons.

Mr. H. M. Stringfellow, Galveston, Texas, sends to the Club six very fine watermelons raised on his farm. The variety, he writes us, is Phinney's Early. He got the seed in Massachusetts, and planted on the 17th of March. Up to the time of writing he had taken nearly 500 watermelons from 100 hills. The hills are sixteen feet apart each way, and one vine only is left to a hill. The soil is sandy loam with a subsoil of pure white sand, which requires constant and excessive manuring; but produces astonishing crops. All vegetables attain great perfection, especially in the fall. Cabbage and cauliflower perfect themselves all through the winter, and he cut from his garden last February a cauliflower that weighed ten pounds after all the leaves were stripped away.

GRAPES FOR TEXAS.

Mr. Stringfellow further stated: "I have 600 grapevines, including twenty-one varieties. They were planted a year ago; but few of your vineyardists would believe it to see them. Many of them now measure one and a half inches in diameter, and eighty Hartford Prolifics are now ripening, quite thirty pounds to the vine, and some fifty. Mr. John M. Jones, a member of your Club, was in my garden a month ago and can testify to the quantity. Several of the Hartfords have bunches entirely covered and almost ripe. We have had almost a continual drouth for some months, and the vines all need rain exceedingly. The Concord does not succeed very well here. It does not ripen its fruit. The Isabella and Catawba are worthless. I am testing the Eumelan, Roger's, Hybrid No. 1, Delaware, Maxatawney, North Carolina Seedling, Union Village, Mary Ann, Ives Seedling, Adirondack, El Paso, Clinton, Scuppernong, Allen's Hybrid, Black Hamburg, Golden Hamburg, Malaga, and Chasselas de Fontainbleau. I believe the foreign grapes are much better suited to our climate than the American. So far as I can learn from the few experiments yet made on the island, the native grapes, with the exception of the Scuppernong varieties and the Delaware, all have a tendency to rot. Mildew seems to be unknown. The Delaware succeeds perfectly; but the grape is too small to suit the Galveston consumers. They want a large, showy grape, regardless of flavor or anything else. There are several arbors on the island of the Chasselas and Malaga varieties that have ripened fine crops for many years and never rotted. I shall cut down 300 Concords this winter and graft the Hamburgs and Muscat of Alexandria upon them. Nearly all of my vines have grapes upon them, and I can give you a better estimate of their value in a month or six weeks, as all of them will have ripened by that time."

Professor H. E. Colton spoke at some length of the Scuppernong grape, saying: "The correspondent whose communication has just been read is correct in stating that the Scuppernong and Delaware are the only vines not attacked in his locality by mildew or rot, and he might have added the Scuppernong vine never fails to yield. I am well acquainted with it, and I never knew a crop to fail from any cause, and never saw a bug or a worm of any kind upon it. It is hardy, and grows on poor soil. This is, in fact, the great trouble with the grape. It grows on such poor soil that the people never take the trouble or expense to cultivate or manure it. It has not of itself enough saccharine matter for a sweet wine; but has, according to Professor C. L. Jackson, the finest aroma of any American grape. It will not flourish in the northern climate and soil, unless in southern New Jersey and Delaware. I think it might be hybridized with some northern variety of the Catawba, and thus make a new grape having the valuable qualities of both, utilizing its peculiarity of non-liability to mildew and rot. To the south it is invaluable. It grows on soils where the Catawba hardly sprouts, yields very largely, is esteemed of great medicinal use in fevers, and acts directly on the kidneys and liver. It is essentially the grape of the south, and there it can have no rival. I only think that northern horticulturists may benefit themselves by making use of its valuable properties by hybridization."

Mr. A. S. Fuller remarked, that the proposed introduction of the Scuppernong had been attempted many times during the past half century or more, and failed invariably. Even if we could grow it here, it would be worthless; as worthless, in point of fact, as the common fox grape of the north. The Scuppernong is of the same class. Besides, even if it had real value, it is long coming into bearing, and, in short, it is nonsense to think of it, even at the south, simply because there are varieties much more worthy the attention of southern farmers. And, as for its wine qualities, I doubt if a quart of pure Scuppernong wine has ever been made. It is the general practice to build it up on a whiskey basis. But the southern climate is well adapted to the making of good wine, provided the vineyardists introduce the proper varieties of grapes. Pray, instead of advising them against their interests, let us encourage them to adopt a better system.

Colonel Harris indorsed Mr. Fuller, saying his estimate of the Scuppernong is doubtless correct in the main, at least so far as its adaptation to the north is concerned; and he cited a recent conversation with a southern cultivator which led him to conclude that even at the south the Scuppernong is likely to be succeeded as a wine grape by the North Carolina Seedling.

Mr. J. W. Gregory stood by the scouted candidate, saying the Scuppernong is the Concord of the south, and that, at least in the New Orleans market, it is sought for in preference to any other grape.

RED RASPBERRIES.

Mr. William S. Carpenter brought from Westchester county some raspberries which he called Coe's Early, a variety which, he claimed, is hardier, more prolific, and sooner ripe than any other.

Mr. Fuller remarked that his place in New Jersey is in about the same latitude as that of Mr. Carpenter, and that he has the following sorts already fit for picking: Davison's Thornless, Doolittle, Fay's Thornless, Monthly Black; and of red varieties, Philadelphia, Clarke, Imperial, Jusqueco, Van Turk, Red Canada, Parry's Seedling, Kirtland, Ellisdale, Elm City, Souchetti, Vareste's large, Arnold's White, Surpasse Fastollf. Mr. Fuller's soil was stated to be a sandy loam, while that of Mr. Carpenter's farm is much heavier.

WESTCHESTER BLACK-CAP RASPBERRY.

Mr. Travis exhibited a basket of Westchester Black-caps, grown at Tarrytown, N. Y. He spoke of this variety as standing the winter well, ripening quite evenly and full ten days sooner than the Doolittle.

Mr. F. D. Curtis said that last week he found the common wild red raspberries, very plump and of excellent flavor, fully ripe, along the fences near his place, in Saratoga county, 176 miles north of New York.

REPORT ON THE SPRAGUE MOWING MACHINE.

The committee, consisting of Messrs. Samuel Sinclair, John W. Chambers, and A. B. Crandell, appointed by the club to witness a trial of the Sprague mower, recently introduced by the senator whose name it bears, reported that they saw the machine in operation last Thursday at Croton, in meadow land, somewhat rough of surface, and containing frequent trees; that the grass was for the most part very heavy, and in many places much lodged; that the mower was not inconvenienced by these obstacles, but worked steadily, for the two hours during which the test lasted, without any stoppage or delay; that it left a stubble closely and smoothly clipped; and that altogether its action was such as to warrant the good opinion of the committee, and also of Mr. John Sullivan, a practical farmer, accustomed to the use of old favorite machines, who kindly facilitated the committee in the discharge of their duties. The chief characteristics claimed for the Sprague, and with evident justice, are its notable beauty and neatness; ease of management; the compactness of the gearing, all of which is inclosed in a tight, safe, and yet quite accessible case; the reduction of friction; the nice adaptation of cutting power to driving power, rendering "clogging" almost impossible, even on short curves; and the comparative cheapness of the implement, the price asked being considerably less than the general range for first-class mowers. It ought, perhaps, to be said that the machine was drawn by very intelligent horses, well accustomed to the work, and that the reins were held by Mr. O. A. Hillman, a gentleman who has given the last dozen years of his life almost solely to mowers, and who is interested in introducing the Sprague. It might also be remarked, with more or less propriety, that the charming weather which characterized the day of the trial, the magnificent views which the field commanded, very delightful to city eyes, the excellent collation prepared by Mrs. Sullivan, and last but not least, the presence of the genial president of the Club, all conspired to put the committee into a very appreciative humor.

On motion, the report was accepted, and Mr. F. D. Curtis took occasion to approve the allusion to the intelligence of the horses. The action of the machine, he said, depends very much more than most people are perhaps aware of upon the conduct of the team. It is important that this be known, because horses may be educated to operate a mower in such a way as to call for comparatively little attention on the part of the driver, or at least to very materially lessen his work.

The Farm of Samuel Sinclair.

Chairman Ely said he visited the farm of Mr. Samuel Sinclair, situated at Croton, just above Sing Sing, on the same side of the river; that the estate is 180 acres in extent; that the land rises from the water, not abruptly, but by gentle elevations, relieved by plateaus, seemingly intended by kind nature as sites for suburban homes; and that no more picturesque views can be found than crop out by scores all over these 180 acres. The writer continued: The noble Hudson looks at this point less like a river than a beautiful series of inland lakes, both ends being cut off from sight by sharp bends and mountain ranges. I traveled some miles, in part over a most splendid drive, and in part over where the expensive path now being made is to pass; all sorts of landscape views may be found, mountain, hill, dale, valley, water, rocks, woods, lawn; in short, all tastes can be suited. Here, in large fields of potatoes, corn and mowing land, were a good dozen of laborers at work with five teams of horses. If any oxen, I did not see them, but I saw plenty of cows, of all the noted high-bred sorts, including the "Kerrey," which was the first time I ever saw this beautiful breed. It is but five years since Mr. Sinclair took hold of these acres, and what he has wrought should be seen to be appreciated. Hundreds upon hundreds of young, thrifty fruit trees, chiefly apple, were in fine condition, and I examined probably fifty, and did not find a worm, or see any trace of apple-moth, or the tent caterpillar. My hope and prayer are, that the New Jersey "curculio" may never visit these 180 acres. The barn is a model, built of concrete. It is large and well arranged, taking all its conveniences into account. I have not seen many who could build or have such a barn. It combines all in one, from coach-house and stalls, and floor for carriage horses, and stalls and floor for work horses, cows, calves. A most interesting party, say six or eight, of the latter, were well worth going miles to see; and a long sort of basement L, extending well on to 100 feet, furnished a cool and safe place for some very large and valuable breeding swine, and at the end a most comfortable place for the poultry in winter. On the opposite side this L was duplicated and used for a cowshed, and overhead a corn-crib. The ground between these two L's furnishes a very convenient barn-yard, on a level with the floor occupied by the cows. The farm-house is pleasantly located, with fine piazzas on two sides, most commodious in size and arrangement, presided over by a refined New England young woman, the wife of the head manager of the farm. And here, in conclusion, I must add that I sat down to a quiet, delightful dinner, for which Mr. Crandall and your secretary and myself are under obligations to Mr. Sinclair and Mrs. Sullivan and her husband, the manager of the place.

POULTRY KEEPING AS A BUSINESS.

The inquiry is from Michigan. "Failing health and declining years make it necessary for me to give up the more laborious pursuits of life; but some light exercise for mind and body is absolutely indispensable. Would the raising of poultry near or within 100 miles of a city market afford a profitable remuneration for the time and proper management required for the business? Being quite unacquainted with the *rationale* of this matter, I prefer to submit it to the Club, thinking that the experience of some one of its members might furnish a solution to the question. How much land, and of what kind of soils, sandy, gravelly or clay-mixed, would be required for 100 fowls (hens and cocks)? Should it be adjacent to a stream of water, or would a living spring do as well? What portion of the grounds should be in trees, shrubs and grass? How many could two aged people care for, and what return might reasonably be expected from 100 fowls in chickens and eggs?"

Mr. Warren Leland.—If this old gentleman will come up to my place, twenty-five miles north of New York, at Rye station, I will show him how I manage my poultry yards. I have found that, for every hundred fowls, you must give up at least an acre. But rough land is as good as any. Hens naturally love the bush, and I lop young trees, but leave a shred by which they live a year or more. These form hiding places and retreats for them. In such places they prefer to lay. I have great success, and it depends on three or four rules, by observing which I believe this old gentleman in Michigan can make a good living by hens and turkeys.

1. I give my fowls great range. Eighteen acres belong to them exclusively. Then the broods have the range of another big lot, and the turkeys go half a mile or more from the house. The eighteen acres of poultry yard is rough land, of little use for tillage. It has a pond in it, and many rocks, and bushes, and weeds, and sandy places, and ash heaps, and lime and bones and grass, and a place which I plow up to give them worms.

2. When a hen has set, I take her box, throw out the straw and earth, let it be out in the sun and rain a few days, and give it a good coat of whitewash on both sides. In winter, when it is very cold, I have an old stove in their house, and keep the warmth above freezing. There is also an open fire-place, where I build a fire in cool wet days. They dry themselves, and when the fire goes out there is a bed of ashes for them to wallow in. Summer and winter my hens have all the lime, ashes and sand they want.

3. Another reason why I have such luck is because my poultry yards receive all the scraps from the Metropolitan hotel. Egg-making is no easy work, and hens will not do much of it without high feed. They need just what a man who works requires—wheat bread and meat. Even when wheat costs two dollars, I believe in feeding it to hens. As to breeds, I prefer the Brahmas, light and dark. I change roosters every spring, and a man on the farm has no other duty than to take care of my poultry. I often have 3,000 spring chickens.

CRUEL TREATMENT OF ANIMALS.

Mr. F. D. Curtis. — My attention has been called to the abuses practiced by the beasts who infest our cattle markets on the dumb brutes consigned to their charge. In summer they are tortured with heat and thirst, in winter with exposure to the cold, and other cruelties which I will not take time here to enumerate. He who extends his hand to ameliorate the condition of the suffering brute creation is a prince among philanthropists. These barbarities must be stopped. I am willing to be one to lash the perpetrators with the scorn of men and the just condemnation of public sentiment until they shall desist. My informant is one who is as competent to speak as any one in our country — Miss Middy Morgan. And I urge action now, for now is the suffering; and "sufficient unto the day is the evil thereof."

Miss Morgan. — It has been my sad duty to make regular visits for ten months past to the great markets of this city, and some of the sights I have seen are deplorable. We all suffer, because it is utterly impossible for the meat of animals subject to such inhuman treatment to be healthy; and, putting out of the consideration all feelings of mercy which we ought to have for these dumb driven creatures, let us at least think and act merely in self-defense. Nine times in ten we eat diseased meat at our hotels and restaurants. It cannot be otherwise. I have been asked frequently to use my influence to remedy the evils complained of; but I confess my weakness.

Dr. J. V. C. Smith.—I am glad the poor animals have such an eloquent champion, and I regret that in the case cited Miss Morgan's petition was not heeded. I trust she may be more successful in time to come. I remember that in the city of Cairo, where there is none of our high-sounding talk of humanitarian schemes, and the inhabitants of which we are accustomed to think of as scarcely half civilized, I saw more evidence of Christian charity in these matters than I have ever seen in our own country, of which we boast.

Mr. J. B. Lyman.—From what I saw the other day at Communipaw, and from things I gather from other sources, I am satisfied the abuses are on the increase. For instance, hogs are brought by the thousand to the slaughter-pens awaiting the knife. In their long confinement some in each car become lame and unable to walk. The rough men who have charge of the animals whip and pound these halting wretches till the blood runs from their ears and nose. Nearer dead than alive, they are pinched and tortured and kicked up as near as they can be forced to the slaughter-pens, and the knife ends their agonies and their squeals. These hogs are dressed with the rest and eaten by our ignorant and unhappy citizens. We have a society whose object and charter look solely to the repression of such cruelties, and I know that Mr. Bergh would be happy to unite with us in any legislation or in any executive action that may be necessary; and I move that he be requested to confer with us and give his views on the proper system for making our cattle transit and our slaughter-pens what they should be.

This motion was, after remarks by Messrs. Gregory and Moulton, seconded, and Miss Morgan and Messrs. Curtis and Lyman were appointed as said committee.

COPPERAS FOR CORN GRUBS.

Rev. Edgar Perkins, Phœnix, N. Y.—I am only an amature farmer, but facts are facts, come from what source they may. I am going to state one for the benefit of "whom it may concern." Two years ago I turned under three-fourths of an acre of sword for corn. I feared the grubs. Just as I was ready to plant my wife (who does not at all believe in newspaper farming), called my attention to a short article on the subject, copied from some agricultural journal into the village paper. Its prescription against grubs was to soak four quarts of corn in a warm solution of one pound of copperas (sulphate of iron). I soaked four quarts of corn for twenty-four hours in a solution of copperas, and planted. I had not quite seed enough, and planted the last five rows with dry corn. Result: At the first hoeing there were not *five* hills missing on the part soaked in the copperas solution. On the five rows there were not five hills standing.

WOODPECKERS.

Mr. Ethan Spencer, Boonville, Ind.—There are six different birds called woodpeckers found from New York to Missouri. First. A very small bird with a blue, black and brown breast, may be known by his almost perpetual motion, while he goes up and down your apple tree talking lonely to himself, and looking in every crack and crevice, or picking worms out of a decayed stick of wood. Second. A speckled bird, a size larger, and which is but a dwarf of the third, both having the same habits and color, and both may be known by their sharp cry; and fourth, the large wood-cock, about the size of a wood-duck, and a bill like a spike and a red head. These four are comparatively harmless, and should not be harmed, but then comes the fifth, a dirty speckled bird, and known by his whining cry, somewhat like a cat-bird, and by his hiding behind the body of the tree to shun your presence; and whenever the sap will run, he picks out the bark down to the wood in blocks until he often completely girdles and kills the tree. They often attack our evergreen, shade, and ornamental trees, as well as apple trees, and all for the sap and life of the tree, and sixth, white and black-winged and red-headed woodpecker. I notice there is a plea made for them that they destroy the potato bug; but I know they both, bird and bug, often occupy the same field here, and I have never known the bird to harm the bug, but if you have any fair apples ripening they will come by the score, and spoil the best, if they are not killed, and they are also great lovers of berries; and then, when corn is in good roasting-ear they will pick holes through the husk, letting the water in to rot the ear, and this for the corn and not for any insect; and in winter they will come to the crib for the corn. These two last named I consider an unmitigated nuisance.

As for the bluejay, I have noticed some plead for him, but I never knew him to do any good unless accidentally, and that he destroys the smaller bird's young or eggs. I have known one to kill an old blue bird by attacking her when on her nest in a hollow stump, and they are natural thieves of berries, grain, etc., and therefore a nuisance; but the robin, wren, martin, and a host of wood-birds, I consider it a sin and a shame to injure them; and nothing that exists tends to enliven nature, or soothe our sorrows and call up scenes of youth and innocence more than their beautiful morning and evening songs. Even our domestic animals must be restrained, and the birds which go everywhere are sometimes a nuisance. They must neither be excused nor persecuted without a proper discrimination.

POTATO BUGS AND CURRANT WORMS.

Mr. Hiram Latimer, Morgan, Ohio, knows how to master these pests. This is his way of doing it: I arm myself with a large tin pan and a paddle eight or ten inches wide, and go for them, thrusting the pan up to the roots of the vine, and with the paddle bringing the vines over the pan with a shake and the bugs are safe; then to another hill, till I have as many as I wish to carry; then with the corner of the paddle dig a hole in the soft earth, slip in the bugs, cover with earth, stamp them down, and proceed to business again. I have but few potatoes destroyed by them. The currant-worm is similar in its habits of feeding; it attacks the bushes in companies, and strips bush after bush. I had plenty of currants till these pests came, and to get them away I tore them up and scattered them away in fence corners around the farm; but of no use, the worms followed. I have a few young gooseberry bushes set out last year. I did not know they would destroy them, but a few days ago I found the worms cutting off the leaves rapidly. I was somewhat moved, and then and there resolved I would save the bushes, if I had to kill every worm with my bare fingers, and without hesitation I fell to crushing their hateful little carcases, when lo, they began to fall to the ground rapidly. Then I saw at once I had made an important discovery. I went to the house and got my pan and paddle, found where they were at work, and went to shaking them into the pan. I found they could be cleared in a short time. The middle of the day, when the sun shines, I think is the best time. The battle probably will have to be repeated. Shake your bushes smartly.

Adjourned.

July 5, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Trout and Trout Ponds.

Mr. A. R. Fuller, Malone, N. Y.—I have been experimenting with trout for two years, and find I can learn something all the time. Make your ponds as near as you possibly can as nature makes them; give them all kinds of bottom, mud as well as gravel. Sand, grass banks, old stumps, bushes, roots, and old logs all hold animal life, and every trout in the pond is on the lookout for anything that moves. Ponds with cement walls will not afford much natural food. I think many gentlemen who build such ponds, and try to make them look fine by building nice walls, starve their trout by feeding only such food as is fed dead. I think they require some live food, though they do well for a time on chopped meat, curd, and the like. Beginning with the small fry, I have fed eggs, hard-boiled, freely with a small net made of book-muslin, putting in a half egg at a time. Wet the net, and squeeze it well with the hand, and rinse off the little particles that come through; they float along and are caught by the fry. Sour milk is full as good. Curdled blood is too heavy, and of too dark color. Great care must be taken in feeding it, as the boxes soon become foul. Turn out the little fellows as soon as possible into good pasture; they will do better than when fed by hand. Keep as near nature as you can, and protect them from their natural enemies, old trout, kingfishers, minks, and water-mice. I turned out our young trout in March this year, and have not fed them anything since. They are now two inches long, as smart as the old ones. These yearlings had not been fed when I took them out to make room for the little ones. They were four to six inches in length. I now feed them chopped meat and sour milk in addition to what they catch, and I take pains to introduce any insect or crawlers that will live in water, that a trout will eat. Our fresh water leech is a very sweet morsel to a trout, and can be easily propagated where trout can feed on them. Clams make good feed; a little more trouble to open and feed them out, but they are better than liver. The question of cheap feed is one of great importance to those engaged in fish culture; everything that will grow with the trout that he can use as food must be taken care of. I do not think any one can depend entirely on butcher's meat or curds. We have been very successful in getting our ponds stocked, and have had very few deaths among the fish. I attribute our success to the make of our ponds as much as to the care. We have built open walls, plenty hiding-places, and good shade among the stones. We have 14,000 old trout, and are now prepared to stock other ponds; began work October, 1868, with thirty two-year-old trout. We have 200,000 young ones, turned out in March. Having so good a start on trout, our study now is cheap feed, and any new light I may get on the subject I shall be glad to impart to new beginners or others, either directly or through your Club. I classed the kingfisher among the enemies of the trout, but am not satisfied that he is one. Last year I tried to drive them away from the ponds; but this year I let them nest in the bank near one pond, and have watched them closely, and have never seen one dive in a pond, and am not sure that they catch trout. Others say they do, but I think so much of anything in the bird line that I want to keep the kingfisher if I can. I would advise all beginners to visit some one engaged in the business, and get a practical knowledge before starting; it will save much time and expense. See how they feed, and the quantity.

LIFE IN THE OLD LAND.

Mr. F. St. J. Barrett, of Petersburg, Virginia, forwarded a few timothy heads, some of which measured ten inches in length, and adorned stalks which stood over five feet high. He explained these were produced in his State, and added: "They are not unusual specimens, and as good could be found on any plantation, the only requirement being tolerable richness of soil. Still, while timothy will grow here, it is not so well adapted to this climate, on account of the form of the root, it being a bulb, as the other grasses, and especially clover.

We are anxious to have the waste places here settled up and cultivated, and I think there is a fine opening for any earnest worker, and valuable returns for his investment of labor and capital." Mr. Barrett also intimated, that he would furnish further facts to such as may be turning their eyes toward the mother of presidents.

Ticks and Weevils.

A correspondent from Eygpt, N. J., wrote as follows: I have been in the practice of making a strong decoction from tobacco stems put in a barrel, and then just set the sheep or lambs in for a few minutes, until they become saturated. Sometimes one application is sufficient. I never knew two to fail to destroy every tick. I would suggest here an experiment for destroying the weevils in barns. The kind I have reference to is an insect resembling a small black bug. Two of my neighbors' barns were infested to an intolerable extent with these insects. The plan they adopted was to knock off the weather-boards from the ground two or three feet up, after taking out all grain and hay so as to allow the chickens and air free access. This idea was suggested from the fact of an old barn standing in the neighborhood having been used for more than twenty-five years, for the purpose of storing grain in the sheaf without being affected. This barn was boarded up and down, and there was plenty of space between the boards for the passage of air.

Mr. H. L. Reade.—I have tried the tobacco cure for ticks, and with excellent results, and have yet to learn of any better method. My mode is to steep a pound of tobacco in from six to eight gallons of water, and then, with an attendant, take the lamb by the hind legs and the fore legs and head, dipping him into the decoction. The one having charge of the head then holds him up over the tub, while the other man squeezes the "tea" out of the wool to be used in saturating another lamb. One pound of plug tobacco will answer for thirty lambs, and they should be dipped about six days after they are sheared as the ticks will by that time have left the bare old ones for the fresher and better covered young.

Worth of Wood-ashes.

Mr. H. L. Reade said that he wished to make a statement with regard to the use of wood-ashes on the lands of the Reade Paper Company, to which he had referred some time before. Mr. Branch, the superintendent of the mill, stated to him that he cut from four to five tons of clover on two acres of land, which had been generally treated to a dressing of ashes (from fifty to seventy-five bushels to the acre) for two years, and that on other portions of the same field that had been manured exactly the same, without the ashes, the crop was very much less. The ashes were a mixture of chestnut and oak. The land was sandy and not very rich.

Mr. A. S. Fuller.—Clay soils do not need ashes, but on sandy land they are certainly invaluable.

HEDGE PLANTS.

Mr. A. S. Fuller spoke of the importance of a larger knowledge in the matter of hedges. He said money was being thrown away on things that were being grown to make hedges of, but which would prove worthless. We want to know what is best for each soil, and each climate, and I move that a committee be appointed to take the whole matter into consideration and report at some future meeting.

Dr. J. M. Crowell.—What is most needed is something that shall serve the double purpose of fruit bearing or nut-bearing and hedge at the same time. I have a row of dwarf pear trees that gives me fruit and makes a fence, much to my satisfaction. The time may come when land here will be so valuable that unless the hedge subserves this double purpose, it will be torn up as too expensive a luxury, as is now being done in England.

Dr. Isaac P. Trimble.—The Dutchess pear answers this double purpose very well.

POISON FOR THE CURCULIO.

Mr. G. N. Smith, Berlin, Wis.—My method of destroying the little Turk is to give the trees a judicious sprinkling of Paris Green. My plum trees are living witnesses of the excellence of this treatment, for they are for the first time loaded with fruit, and some of them overloaded, and not a mark of the curculio can be found. This is the third season in this region that we have used the Paris Green for destroying the Colorado potato beetle, and I find it effectual not only for them, but for all insects that feed on the foliage of trees or plants. No other preparation, as I am aware of, has yet been used that is so inexpensive and easily prepared and applied as this. It is a perfect protection to the melon and squash vines against the ravages of the striped bug, to rose bushes from the slug, and the currant and raspberry from the worm. This is as far as my experience extends; but I see no reason why the canker worm, and the caterpillar could not be destroyed by this preparation. Last season I applied the Paris

Green to my trees, and I was satisfied it had its effect on the curculio; but the season was so cold and wet here, and insects generally were so scarce and the fruits rotted badly, I could not fully decide. But this season the unusual warm weather brought them out early, and on noticing their marks on the fruit I made an application of the Green to my trees and repeated it every week or ten days. The fruit that was stung dropped off, but it is the last I have seen of the curculio, although in other localities, where it has not been used, they have been constantly at work. My manner of using this poison is to mix thirty parts of flour or fine middlings to one of the Paris Green (this is the same proportion as we use on our potato vines); take a two or three-quart tin pail and perforate the bottom and fasten to a pole, and while the dew is on shake it over the tree, standing on the windward side and not inhale any of the dust. A light dusting is sufficient, and it will be found strong enough for all practical purposes.

Mr. A. S. Fuller.—I know Paris Green is sure death to leaf-cutting insects, but I was not aware the curculio is of this class. It is barely possible the effect of the application to the plum trees may not be so apparent another year. I have frequently seen "certain cures" which worked very well for a single season.

Dr. I. P. Trimble.—I do not think Paris Green or any other ingredient so poisonous is to be recommended as an application to fruit trees or vegetables.

Dr. J. V. C. Smith.—It is doubtful whether a mite of the poison is taken up by the sap of the plants or fruits; but as little might adhere to the coat and be swallowed, the practice of using a rank poison on fruit trees cannot be recommended. With potatoes the case is different.

Report on "Warner's Rake."

Your committee on the working of "Warner's Hay Rake," attended the operations on the grounds of the college, at New Brunswick, N. J., on Thursday, and report that the raking of the hay, then nearly terminated, had been done by the Warner and another rake, under the personal supervision of Prof. Cook, who was present at our examination and kindly aided us with explanations. In several respects the Warner rake possesses points of superiority. It is substantially made, easily controlled, will back or turn sideways, being furnished with casters; these regulate the rake and prevent it from harrowing or scratching the ground, thus avoiding the cloud of dust that too often accompanies the horse rake, spoiling the hay, and at least endangering the horses' wind, which consume it. It is easily fixed to move from one field to another with safety. As the rake with the lever, etc., can be easily detached from the carriage part, and easily attached to the fore-wheels of any light country wagon, for one-half the cost of the whole, we think this an important feature, as it will place it within reach of a large class of small farmers, who might not be able to buy a rake complete.

The attachment can be bolted to any axletree, and by expending fifteen dollars any farmer can have the use of as good a rake as there is before the public. It occupies but little space during winter, and the parts that may break can be repaired by any man who knows how to pull a draw knife.

J. B. LYMAN,
J. W. GREGORY,
Committee.

Prof. George H. Cook, writing from the agricultural department of Rutgers College, adds:

"The Warner horse rake has been tried upon the college farm the past season. It is a revolving rake, attached to a sulky, is under perfect control, runs light and can be managed by a boy.

The attachment of casters renders it specially easy of management in backing or making very short turns. I consider it to be a first-rate rake, and can confidently recommend its excellent qualities."

CROWS.

Mr. Gilbert Smith, of Highland Falls, N.Y., wrote to say that he is a great lover of birds, and does all he can to encourage them, even going without cat or dog on their account. "There was" he continued, "a time when I suffered those niggardly theives, the crows, to come upon my premises, and I have even fed them in hard winters, but that was before I knew them. I must run the risk of being voted behind the age by voting against the crow, and should feel perfectly justified in being a *repeater* on that question. It is a great mistake to suppose that crows will condescend to feed on such common stuff as caterpillars or grasshoppers, or any other troublesome insect, so long as they can find young birds, or turkeys, or chickens. I have caught them more than once in the very act of breaking up a nest of young robins within a few rods of my house. Like sneaking thieves, as they are, they come before you are up in the morning. I have been aroused by the agonizing cries of the old ones in their efforts to save their young, but generally just in time to see the black robber make off with his plunder. Only this very day, as I was sitting by the door, trying to keep *cool*, my blood was made to *boil* by seeing one of these black imps flying past the house with a young robin dangling from his beak, with the parents in hot pursuit, and with such mournful cries as would almost bring tears to the eyes of a robin *shooter*. Please excuse me for this intrusion; but after reading the remarks of some of the members of your Club on this subject I thought a few words from one who is somewhat familiar with the habits of the crow might not come amiss."

Mr. A. S. Fuller.—He is wrong about grasshoppers. I have found them in the stomach of crows repeatedly. It is true that crows, when tame, refuse to eat eggs; and I think, if they are so fond of birds as our correspondent says, some of us would have at least seen one instance which would have evidence in that direction. There are in my county enough crows to consume all the small birds in the State if they were inclined to that sort of game in its season.

Mr. J. W. Gregory.—It is not barely possible that there are two kinds of crow, and that the one our correspondent is thinking about is not the one we are talking about? Perhaps he means rooks.

Dr. I. P. Trimble.—There are no rooks east of the Rocky mountains; but, if there were, their habits are the same. I, for my part, have never known of a case of crows eating smaller birds, and I doubt the statement.

BLIGHT.

Mr. H. W. Myers, of Agency City, Iowa, stated that his fine young pear trees are about to blight, and he would, of course, save them if he can. So he brought his grief to the Club.

Mr. S. B. Parsons.—I fear we cannot give relief. The blight has puzzled us all for twenty years, and we are still no nearer a solution of the mystery. It may be of some service to remove the branch or branches most affected, but, like black knot, it is almost certain to return. I feel in regard to these matters, blight, smut, mildew, and kindred afflictions, somewhat, I suppose, as a physician must feel in treatment of cases which baffle his skill. There are in the physical as well as in the moral world, more complications, traceable to causes beyond our ken, than are dreamed of in philosophy.

GREEN ISLAND GRAPES.

Mr. P. Stewart, one of the members of the Shaker community at Mount Lebanon, forwarded a communication, in which he described a visit made last fall to the vineyards of Mr. David Thompson, located at Green Island, near Troy, N. Y., the fame of which had reached him. But the half was not told. "Though I have many new seedlings of my own—pronounced most excellent, too, by good judges—still when I came to taste of friend Thompson's grapes I found the flavor of many of them equal to our hot-house varieties, and some of the clusters weighed two and a half pounds. Although my visit was made some two weeks after the height of the season, yet I saw vines, several whose prolificness far excelled anything commonly seen upon the Isabella in its best location. If his new varieties of black grapes do so well in other sections of the country, they must prove an acquisition of great value. Truly he and his family deserve to be placed beyond the reach of want for his arduous and long continued labors and unpretending achievement in this line. I learn, upon inquiry in the immediate neighborhood where friend Thompson has lived for so long, that a more unpretending, truthful and just man they have never known. This being his character, it is certainly much to be regretted that there are parties who, through windy and smooth promises, filch and steal away all the tangible profits that our good friend Thompson has spent so many years of hard labor to acquire, and have already damaged him to quite an amount. I therefore, in order to fulfill the golden rule, respectfully suggest the propriety of appointing a committee to visit friend Thompson's grapes, to the end that justice may be done.

The Chairman.—Such a committee was appointed some months ago, and we shall expect them to do their duty in their own good time.

Mr. A. S. Fuller.—Of which I am one, and it is our intention to go to Green Island when the grapes are ripe, and see for ourselves. The results accomplished by Mr. Thompson are noteworthy, to say the least, and it may be a matter of some consequence to decide whether his promise will succeed in other sections of the country.

SMUT IN WHEAT.

Mr. William Cunningham, Caldwell, Ohio, forwarded one head of wheat and one of smut which grew side by side, and asked the opinion of the savans as to cause and cure.

Mr. A. S. Fuller.—The smut is probably owing to the season, which seems to have marked its course—at least in many localities—by the prevalence of this disease, or whatever it may be called.

Mr. J. M. Burdeck.—My father, who was a miller, used to say the more snow the more smut. It was his theory that the heaving of the soil weakened the plant, and left it susceptible to the attack of the fungus.

Dr. I. P. Trimble.—It is proved that smut is a fungus, and that it is a great help to keep the seed pure.

Mr. J. W. Gregory.—I am familiar with some experiments, the result of which seemed to place beyond doubt that the crop grown from seed soaked in urine will not be attacked.

Mr. Curtis.—My father was accustomed to soak the seed in strong brine, and then roll in lime, and it worked well. The brine sinks the pure seed, and that which is defective rises to the top and is discarded. It is, in effect, simply a sifting process.

Adjourned.

July 12, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Burning Straw.

Mr. John Wragg, Waukee, Iowa, desired to know whether he had better plow under dry stubble straw, corn stalks, etc., or burn it on the ground? "Now don't hold up your hands in horror at the idea of burning straw. Please remember that I am on the prairies and not in the vicinity of New York. Take my case as a sample of thousands of others. When I thrash my grain I save all the straw I possibly can use, and stack it in the yards for the cattle and horses to run to all winter. They have all for shelter and bedding they can use, and, to sum up, I save all I can make into manure by the next summer; the balance I must either leave in the field, an unsightly object, for three or four years, to breed weeds around the edges, a bad place to plow and reap around, and, when it has finally decayed, not leaving half a dozen loads of good manure, or burn it. For many years I have preferred the latter, and have plowed under the ashes. What does the Club say?"

The Chairman.—A lazy man would say burn it. A better farmer would say plow it under.

Dr. I. P. Trimble.—I never knew a good husbandman to burn his stubble.

Mr. T. H. Leavitt.—I once had a conversation with a Michigan farmer who mows no less than 1,200 acres, and does other things on a similar scale, and he said he could not afford to fire his straw.

Mr. A. S. Fuller.—It depends very much on what the character of the soil happens to be. I have seen thousands of acres in Wisconson which was so rich that some stratagem of this sort was wisdom.

MULCHING VINES.

Mr. D. W. Humphrey, Fairbault, Minn., "I have about a thousand vines, set two years ago. A part are bearing this year. Some of them are on a hill side where the ground will wash in showers. Our summers are usually hot and very dry. Will the vines grow luxuriantly under mulching, and will they fruit as well and the fruit *ripen* as well? Which is the best mulching for them, straw or coarse manure? The expense of either is only the cost of drawing and putting on."

The Chairman.—What says the author of "The Grape Culturist?"

Mr. A. S. Fuller.—I dislike to talk on the subject. If I should give this man advice I might make a blunder. If we could foretell the weather and knew in advance what kind of a season we were to have, then it would be safe to recommend or disapprove of mulching. Upon the whole, I think a man would be safe in applying mulch to vines planted on a light, dry soil; but even in such a position I have known vines to lose all their fruit from an excess of moisture. I prefer straw, unless the land is very poor, in which case it may be better to use manure.

Dr. F. M. Hexamer.—From what I have seen I judge that nine times in ten the vineyardist is better off who does not mulch his vines.

Mr. A. S. Fuller.—But you would keep the soil well cultivated?

Dr. F. M. Hexamer.—Certainly.

CROWS.

H. J. Perry, M. D., of Seneca Falls, N. Y.—Don't you think the crow question has been discussed about enough? For my part, I think the crow subserves about the same use in a community as the bed bug, and I think that all practical farmers think the same way. I set him down as a thief of the first water. He will pull corn and rob birds' nests, and commit other depredations too numerous to mention, and should be treated as an outlaw and shot whenever found. Sitting in the Farmers' Club rooms and praising the good qualities of the crow, and going forth in the hot sun to replant half of a cornfield after having your corn pulled by the crows, I consider as too sides of the question; and I think if our friend, Dr. Trimble, had to personally superintend their planting a few times in a season his views of the bird's good points would change radically. There may be something in having green corn in the fall when the crop should be harvested, but not enough, in my opinion, to cover the loss.

Mr. F. D. Curtis.—This writer is prejudiced, and, consequently, all wrong. There are woods on three sides of my farm, and they are always populous with this bird of contention; but all the corn they pulled this year was replanted in an hour and a half. So much for their corn-pulling propensities. The other nine or ten months of the year they are foraging on insects injurious to vegetation.

Dr. Isaac P. Trimble.—But I *have* had practical experience in replanting. The crows, some years ago, pulled the better part of the young blades from four acres, and I put in the seed again with my own hands and hoe. Then I caught a young crow, and suspended him by the heels in the middle of the field. His companions hovered about him, but they could not give relief, and so went away; and crows troubled me no more that year, nor the next.

Mr. Gilbert Smith, Highland Falls, N. Y.—As some of your members seem to doubt the truth of my statement in relation to the bad habits of crows, I beg leave to say a few words in reply. I did not say that they would not eat grasshoppers or caterpillars under any circumstances, but that they *preferred* young birds; and I inferred this from the fact of having seen them fly directly over an orchard that was alive with caterpillars, and light in a grove of forest trees near my house, where they could find young birds and no caterpillars. Now if the doubting members should deem this to be a subject of much importance, and will honor me with a visit, it will afford me great pleasure to entertain them to the best of my ability, and at the same time I think *we* shall be able to convince them that crows *do* sometimes devour young birds.

Mr. A. S. Fuller.—That "sometimes" is well put in. Perhaps they will eat birds if starved to it. I have seen hogs eat meat when very hungry, but are not, for that matter, to be classed carniverous.

Cruelty to Animals in the Cattle Yards.

The committee, consisting of Frank D. Curtis, Miss Middy Morgan and J. B. Lyman, to whom was referred the subject of cruelty to animals as practiced in the cattle-yards of this city, reported that there seems to be great indifference, if not absolute neglect, on the part of drovers and the proprietors of these yards for the comfort and health of the unfortunate animals which unhappily fall into their hands; in fact, in many instances there are perpetrated in these yards cruelties and continued persecutions upon these speechless victims of man's greed which appeal to our sympathies, and demand from every human being a stern, unflinching and continued warfare against these atrocities, until the evil-doers shall be shamed into reform, or, lacking that, the strong arm of law shall be invoked, to create and enforce a protection and care for our market animals which does not now exist. From persons who are familiar with the stock yards of this city, we learn that these yards, as far as concerns horned cattle, are quite open, and when cattle are unloaded from the trains, they, as a general rule, are fatigued from a long travel; that said yards contain no adequate convenience for said fatigued cattle; on the contrary, the supply of water is not sufficient in hot weather, the troughs are foul, and the water muddy, whilst in severe winter weather the troughs are frozen over, and constantly the cattle lick the ice or eat the frozen snow to obtain wherewith to quench their thirst; that dry hay is the food supplied in all seasons, and that the condition of the cattle pens is filthy and unwholesome; that fat cattle suffer extremely in hot weather, and fat bullocks have been seen lying at full length on the floor of the pens with their tongues lolling out of their mouths; that no water was given to these exhausted animals, nor thrown on their heads, as it should have been; that in severe winter weather the light steers suffer extremes from the cold; that they come off the cars bruised and crippled, and quite unfit to withstand the chill that all degrees of cattle suffer in such weather; that their tails are frozen for several inches, as also are the long hairs on their flanks and ears, and their beards are icicles; and lastly, in wet or damp weather the pens are a sea of slush, filthy and noisome, emitting foul and deleterious vapor; and steers have been seen dragged out of said slush and obliged to have their throats cut to prevent them from dying. All these facts go to prove that the cattle slaughtered for the consumption of this city are generally in a fevered condition, and consequently unfit for human food. The sheep houses are better than the cattle pens, being protected from the weather, but that the sheep and lambs are therein constantly overcrowded, and when being changed they are cruelly treated, driven over-fast, and thrust on to the scales so closely packed as to be quite unable to stand, but are crowded one on the other, and are in this manner made unfit for human food. The hogs are treated in so gross a manner as to baffle description. Their pens are filthy beyond imagination, and their flesh cannot be otherwise than highly deleterious to the health of human beings. The foregoing facts go to prove the need of reform in the cattle-yards and pens of this city and of its vicinity; or, if such reform is not accomplished, that disease in its most loathsome form is likely to ensue, as fevered animals are unfit to be slaughtered, and that they require time, and shelter, and good food and water, to recuperate previous to being slaughtered. Mr. Bergh, in his report for the year 1869, in relation to the cruelties practiced on dumb animals, speaking of the cattle-yards, says:

"It is not the intention to review the dreadful sufferings inflicted upon animals brought to this market for human food, by reason of the negligence, indifference and meditated cruelty of railroad directors and agents in their transportations, forming a degree of heartless turpitude too monstrous for belief, but only confining himself to a brief allusion to that portion of their prolonged miseries associated with their confinement in the great depots of this city. It has been the habit of the president to visit these places during the past winter, choosing the most inclement days for so doing. On several occasions cattle were found in nearly all of the yards, but notably so at One Hundredth street, near the Third avenue. At this place, which is situated upon an elevated part of the suburbs, wholly exposed to the north and west, and unprovided with the least shelter or protection of any sort, were hundreds of animals, sometimes having a thick crust, which having fallen upon them in the form of snow, had, by reason of the temperature of their bodies, or a drizzling rain, followed by a sudden fall in the mercury, become a coat of ice! Here, exposed to the blasts of winter, were those miserable creatures, the passive instruments of man's cupidity and cruelty, kept for many days, stingily supplied with a little hay, presenting a spectacle from which the Christian or simple humanitarian would sorrowfully turn, with a painful conviction of the distance which yet exists between ourselves and that real civilization of which this generation boasts. To witness this deliberate cruelty and not make an effort for its suppression, would be a reproach on your society too onerous for endurance. In vain our president pleaded that dealers in wood, iron and lignum vitæ regard it essential to protect the same from the weather; but it was of no use, the fiat went forth to the poor brute: "You must suffer yet awhile, until the sentiment of mercy, impartial and indiscriminate, shall be recognized as the right of every living thing." It is an encouraging fact, however, to note that in the present, as well as all other cases where failure, in the form of legal conviction, has followed our efforts, that a moral effect results therefrom, by directing the thoughts of the negligent and indifferent to the subject, and ends in effecting, however tardily, the very reforms sought for.

Covered sheds could be easily provided for the protection of cattle, as is now the case with milch cows at One Hundredth street and Third avenue. It is probable that the cupidity of these dealers is such that no outlay of this kind will be made, unless they be forced to do it by law; such a law should be enacted, and provisions also be made for the appointment of an inspector of cattle-yards, with necessary assistants, who should be authorized to arrest on the spot, any butcher caught in the act of slaughtering any crippled or exhausted animal. To arrest the vendor of such meat involves too much trouble; but to secure the protection of the public, the villains who would dress this flesh for food should be made to suffer on the spot, and the animal be put out of the way of doing any harm. In conclusion we would urge upon the health board of New York the importance of this reform as a sanitary measure, and that in the cattle-yard is the place to correct the evil by obtaining possession of the animal before it shall be slaughtered and offered for sale at the butcher's stall. Self-interest, after a few examples had been made, would compel the drover to exercise more mercy and care, and the yard-keeper to afford better facilities for the comfort and healthfulness of the animals committed to his inclosures.

Dr. F. M. Hexamer, New Castle, N. Y., brought a number of baskets of raspberries, and spoke of them briefly. At the outset he remarked that this fruit has never before been so abundant nor so cheap. When Mr. Fuller, who has done more than any other man to encourage the culture of small fruits, advised people to embark in the business, he did not mean that they should push ahead blindly, but that they should use sense and judgment. This has not been done in all cases. If it had, blackcaps would not now be selling for four cents a quart. The crop, however, had better be dried than be disposed of at such rates. Dried, it sells for forty to sixty cents a quart, and four quarts of fresh berries make one of dried berries, while the trouble of drying is offset by the expense of shipping. Blackcaps are also excellent for canning, and besides this makes excellent vinegar. Dr. Hexamer then proceeded to speak of the varieties. The Ellisdale is earliest, and though a variety of the Purple Cane, it is much preferable to that in every respect. Next in point of ripening is Davidson's Thornless, which, as its name signifies, is destitute of thorns, and therefore agreeable in the garden. It is three days earlier than the Doolittle, which sort is the most prolific of any.

The Garden has more of the red raspberry flavor than either of the blackcaps, but though approved for home use it is not quite suited for market. The Seneca is late, coming ten days after the Doolittle. The excellence of the Mammoth Cluster is that the berries hold the same good size to the end. Though there are two or three dozen other varieties, these are the chief and most worthy. In reply to a question, Dr. Hexamer said he would advise farmers who wish to cultivate some of this fruit simply for home use, to plant Doolittle for black and Philadelphia for red.

Peat for Farm Use.

Mr. T. H. Leavitt, of Boston, Mass., author of a work entitled "Facts about Peat," read a carefully prepared paper on the preparation of this material for fuel, and its use for numerous purposes in common stoves, in furnaces of steam boilers, iron-smelting works, etc. The principal portion of the address was of interest mainly to those having to do with manufacturing operations, but the following extracts, referring to the utilization of peat by the farmer, with little or no machinery, and in his own premises, give a clear idea of the value of the substance to the agriculturist as viewed by Mr. Leavitt: Even without machinery, almost any farmer owning a peat bog may provide his yearly supply of fuel in less time and with less labor than he is accustomed to bestow upon the wood which he cuts from his wood lot, and, when accustomed to the use of it, he will find that his wife will give it the preference for convenience in cooking—certainly for heating her irons on ironing day, and in the coldest days of winter he may have such a fire for his family as will astonish them, and may give his friends a reception so warm that they, too, will either want to manufacture the fuel or induce him to make a larger quantity, and supply them; and in this way it is by no means improbable that many may find a business growing up and a source of ready income hardly second to their farming interest. No one who manufactures it need lack for a market, for every man's neighbor is a consumer of fuel, and will, by no means, prove an unwilling customer when he can get a good fuel cheap. With reference to peat as a fertilizer, I believe it possesses a value to the farming and agricultural interests of the country far beyond what is generally accorded to it. During two seasons I have prepared it in the form of a poudrette, compounded with the meat scrapings and bone scraps from a glue factory. The peat is first prepared, the other materials are dry and mixed with the peat, and the whole is pulverized together in a mill. The peat is "highly concentrated vegetable food;" the decomposed flesh or animal matter is the strongest ammonial substance we get; and the peat being a powerful absorbent of the ammonia, retains the full strength of it for the use of the plants, while the bone gives to the whole the added value of a phosphate, with the properties of which all are familiar. It is nearly odorless, and costs about fifteen dollars per ton to make.

The Chairman.—We have had this subject up here from time to time, and so far as using peat for fuel is concerned, it has in this vicinity proved a total failure. A friend of mine put $30,000 in the business, and lost it—every cent. Just as soon as it is shown that peat can be prepared so that it shall be equal to coal and cheaper, there will be demand for the article, and arguments in its favor will be uncalled for.

THE SCUPPERNONG GRAPE.

C. W. Garrett & Co., Ridgewood, N. C.—In the report of June 29 we notice the remarks of Mr. Fuller on the Scuppernong grape. He either knows nothing of what he is talking about or designedly misrepresents this grape. It will not grow to any advantage north of the line of this State, nor further west in the State than Raleigh. We believe it will do better in eastern North Carolina than any where in the world. It does not belong to the "Fox" class of grapes, having distinct characteristics. It commences to bear the third year, and will bear as much fruit the third year as the Concord or any other vine. It is capable of producing 2,000 gallons of wine to the acre. We offer to prove that the must from this grape, properly cultivated, will weigh, on Oeschle's scale, ninety-eight degrees of sugar. We have the official statement of Dr. Antisell, department chemist of Washington city, that the wine capacity is equal to any native grape, showing from ten to fourteen per cent of alcohol. We have wine in our cellar, which we have recently compared with Johannisberger, for which we paid eight dollars per gallon in New York, and we think Mr. F. cannot decide which is which. We have five acres in grapes from which we made, last season, 6,000 gallons of wine, and we have one acre for which we would not take $2,000 to-day. We use no whiskey or any form of alcohol in our wine, and we are making sparkling wine, white and red, which we are willing to have tested with any native brands of wine. We know vines in this State which have borne crops for sixty-five years without a failure. It has no disease. It blooms after all danger from frosts has passed. The Walter Raleigh vine, on Roanoke Island, which was three inches in diameter in 1610, now covers an acre, and last year produced $3,000 worth of wine. One vine in Tyrrell county, N. C., last year produced 2,530 gallons of wine. It is a natural sparkler, and admirably adapted for making sparkling wine. These facts we are prepared to establish, and could say much more for the grape if we could be heard.

EFFECTS OF THE SUN ON THE POTATO BUG.

Mr. A. W. Warren, Rockford, Ill.—Of all the remedies for the Colorado bug (and I have tried all I have seen recommended), none are so cheap, effectual and rapidly destructive of these pests as knocking them from the vines at midday, say when the thermometer marks eighty-five, or upward, in the shade, the hotter the better. Here in the sand of the Rock River valley, the hot sun destroys them sooner than anything else I ever tried. A paddle, made of a piece of clapboard, three feet long, to allow the operator to stand up to his work, is all the weapon needed. Pass through the field thus armed and carefully jar them from each hill, one row at a time. Pains should be taken to throw those falling in the shade of the vines out midway between the rows, as if left within reach of the vines some will climb up again and escape; but once in the sand they never get four inches away. Occasionally an old one will fly. I have tried on a small piece, the rows being seventeen rods long, passing through as above stated, and before I could get back on the second row, those that have fallen from the first are dead. In cool or cloudy weather, the Paris Green is beyond question the best remedy, but the process of applying it is slow and tedious, and it needs to be used with great caution. My way of applying it is, after thoroughly mixing it with flour, to tie up a small quantity, say half an ordinary tea-cupful in a muslin cloth, with a string long enough to tie round the end of a light stick three feet long. Take this in the left hand, and with another of the same length in the right hand, rap lightly on the first, holding it over the vines, which powders them, very nicely, care being taken so that the wind, should there be any, will carry the powder from you. Hand picking is especially objectionable, as the bugs are equally as poisonous as the Paris Green.

Mr. G. W. Sweet, Cheshire, Mich.—When the day is hot we brush the larva of the potato bug into the spaces between the rows, where they perish on the hot earth. To satisfy myself that this would kill the bugs, I also placed four or five of them on the sand, and left them struggling and crawling about, though making but little headway. On looking after them, in about an hour, I found them all dead beyond the chances of resurrection.

HOW TO KEEP BUTTER.

Mrs. Mary A. Lee, Caln, Pa.—Butter made in October or November, if good, may be kept so by printing in small table prints, and sprinkling each with salt, and laying loosely in a stone jar.

Mr. J. B. Lyman.—I have known it so kept till April, and all good when eaten; the last as good as the first. To keep butter good that is made in the fall is one thing, but to keep that good that is made in the early summer is quite another. Our best and richest butter is made in May, June and July, when the cows milk strong, and before the flies trouble them too much. The best of butter may easily be kept good till April, too, and here is the way I do it. First; it must be good butter when made, all the butter-milk must be worked out, and in doing this keep it out of water; don't have any water come in contact with it, it spoils it; butter that is washed in working, as it is termed, if good, would be much better if it had not been washed. Salt to suit the taste of those who are to eat it, half an ounce of salt to a pound of butter is about right; keep out all your saltpetre, sugar, or other curative ingredients; it will keep better without them, and perhaps too, without salt but would not be so palatable. Do up the butter each week, or churning in one or more neat round rolls of two or three pounds each, just what you have to put down; cover each roll with a clean muslin cloth large enough to go round it twice or more, so that it will be completely enveloped, and sink it in a strong brine, as strong as the best salt will make it. Stone vessels are the best, and each roll, as it is put in, may be sunk by placing a clean stone on it. Continue to add more rolls until the vessel is full, always keeping the whole completely covered with brine; and to insure strength, add more salt when full. Keep it in your cellar or in your spring-house, and see if it is not worth in winter or spring one hundred per cent more than any winter-made butter. In this way I have kept all our winter supply of butter for many years, and have never yet failed. But mark, the butter must be good, well made, by one who understands how; must be well worked, and should by all means, be wrapped up and sunk under the brine the same day it is churned, not kept lying about for two or three days after churning. We here think a good spring with the water at fifty-six degrees indispensable to make the best No. 1 butter in the summer months, and then it must be churned slow that it may come solid. Bradley's atmospheric dasher attachment is superb, making our old barrel churns complete atmospheric churns, with half the revolutions, breaking the butter just as soon; then, in warm weather it is solid, firm, and no trouble to wash out the milk.

Mr. Harris Lewis, in his paper on dairy farming, gives the following rules for churning and making butter:

First. His cows must have good, sweet, dry pasture; clover and green grass make the best butter. The sweet-scented vernal is supposed to give a flavor, but it does not last after June. To keep cows away from all weeds, and out of mud, and never run a dog or pound them, is the chief requisite.

Second. Milk fast and clean, and set in a room of which the temperature is about sixty degrees by the thermometer.

Third. Skim very clean, mix no sour or curdled milk with the cream, keep the cream at sixty degrees or lower, but let it be from three to five degrees warmer when you churn.

Fourth. The best churn, that is the cheapest, that makes the best butter, is the old up-and-down dash. But it is dull, slavish work, and has been to a great extent replaced by barrel or crank churns, of which Blanchard's is the best.

Fifth. Work out all the buttermilk, using a clean linen cloth as an absorbent, salt half an ounce to the pound and lay away for a day; rework it, adding half an ounce more of salt if the butter is for the firkin or a distant market. But half an ounce to the pound is enough, if the butter is to go on the table within two weeks. Keep it below sixty-five degrees till it is spread.

Mr. J. Q. A. Lobingier, Laurelville, Pa., desired information about applying salt to wheat, how and when?

Professor J. A. Whitney.—No reliance can be placed beforehand on the action of salt in any given case, or for any given crop, for the reason that its operation may depend upon any one of a dozen different causes. If there is a deficiency of soda in the soil salt may supply it; the decomposition of the salt may, by liberating one of its components, chlorine, hasten the germination of the seed, this element being believed to have this effect specifically; or the salt dissolving in the soil may, as is known to be frequently the case, help the solution of insoluble phosphates. The ash of wheat kernels contains nearly four per cent of soda, the ash of the straw nearly two and one-half per cent, and that of the chaff more than one and three-fourths per cent. It is likely, therefore, that salt will prove beneficial to wheat, but this can only be found by actually applying it to a piece of ground and watching the result.

THE ANNUAL ADJOURNMENT.

Dr. J. V. C. Smith called attention to the fact that the time for the regular yearly recess had arrived, and he moved that the Club stand adjourned until the 23d of August. This motion was carried.

August 23, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

Before introducing the regular order of business the chairman made some well-chosen remarks welcoming the members, one and all, to their accustomed places, and alluded especially to the delegates who, in the interim, had journeyed to and from the Pacific coast; and expression was given to the hope that they would generously shine for the benefit of the stayers at home.

Mr. H. L. Reade, president of the excursion party, replied, that probably no company ever crossed the continent and returned, with greater reason to be satisfied with the expenditure of time and money. Upon our arrival in San Francisco, he continued, we were most cordially received, and, during our eight days' stay, received invitations from persons representing nearly all the material interests of that magnificent State, which, had we responded to completely, would have taken us several months. We sent delegations to nearly all points, who saw something of nearly all the industries; and on the last evening of our stay, we met a very large number of those who represented nearly all the different pursuits on the western slope. Each spoke of the business in which he had an interest, and an amount of information was obtained that would have required months to otherwise gather.

HINTS ON HEDGING.

The opening communication was from Mr. K. N. Guiteau, Farmington, Minn., who expressed his sentiments as follows:

Fencing here is the great item of expense to the farmer; distance from timber and other fencing material, and their scarcity, being an evil common to all prairie countries. But in Illinois, Iowa and the more southern States, hedges can easily be set and maintained of Osage orange, honey locust, etc. In our State, fencing is still more difficult. We have the same paucity of stone. Timber for fencing is expensive, and yearly growing more so; and none of the hedge plants now used but fail, either from the heat of our summers or the extreme cold of our winters. The maclura here is worthless, as it dies the first season after setting, from the extreme cold; the honey locust ditto, as both extreme heat and cold destroy it. Evergreen plants do well, but, of course, make only hedges for screens, and are no protection against cattle. The willow is by far the best plant that has been extensively tried; but it takes a long time before it attains size enough to be of any practical value, and there are also many other well-known objections to it. But nature has furnished us a plant in great abundance that seems, from my experience, to be just the one thing needful; and I greatly wonder that some one beside myself has not, long ere this, experimented with it. The *Zanthoxylum Americanum*, or northern prickly ash, toothache tree, is very plentifully distributed in this State and northern Wisconsin; and possesses, for a hedge plant, the following desirable qualities, which I know from personal experience:

First. As to climate, forty-two degrees below zero has no injurious effect upon it. The present drouth, which has been unusually severe here upon the Vermilion prairie for several weeks, has failed to injure the two year old plants raised from seed, which have not the slightest protection, and have neither been mulched nor watered.

Second. It is easily raised from seed, which ripens in August and September. The seed should be sown in the fall, about one-half inch depth, and the plants appear early in the spring.

Third. It is naturally a shrub, and does not attain to great size as a tree, but when cut back throws out a thick mass of horizontal branches.

Fourth. It is easily kept in order by the knife or shears.

Fifth. Its numerous short, thick and pointed thorns render it the dread of all kinds of stock, so that it is impossible to drive a cow or horse through even a natural thicket of it in the woods.

Sixth. Its bark, twigs, leaves, flowers and seeds are so extremely pungent that no rabbit, horse, cow, or other animal, will injure it by gnawing or browsing.

Seventh. It is a beautiful shrub, and when covering with seed or the open panicles, is highly ornamental and very aromatic.

A few words as to setting out a hedge. Although so easily raised from seed, when thickets can be found within reasonable distance, my plan would be to take a brush scythe and cut down the plants to within an inch or two of the ground, in the spring or fall. Take a fork and pitch out of the way the prickly brush, then dig up the plants with as many roots as possible. Thoroughly plow and pulverize the soil where they are to be set, at least five feet wide. Set the plants in two rows, two feet apart in the rows, breaking joints. Do not plant upon a ridge, except in wet or damp soils. On common prairie soil give the plants flat culture, and plenty of it. When one year old, cut back to within one or two inches of the starting of the new growth. When two years old, cut back to within six inches; the third year, if the bottom is well established, two feet will do; if not, cut back until the bottom of your hedge is thick and strong. Once get the bottom right, and the top will take care of itself, with a little aid from the shears or knife. Thus, with less care than you would bestow upon almost any other, you will have a fence that will turn either a bull or a cat. This question of hedges is a very important one, and its importance will yearly increase. Let those who can try, in a small way, the northern prickly ash, in different localities. For, if it succeeds as well in other places as it does here, it will soon be in demand. If any one desires a small quantity of the seed for experiment, and will send me their address, with a stamp inclosed, and a small sum to pay a boy for gathering it, I will most cheerfully send it per mail. I have no seed for sale, and do not mean or wish to speculate in it; but a limited quantity of it can be gathered within two miles of my residence.

Mr. F. D. Curtis.—There is some prickly ash on my farm, and in a protected place, too; but the new growth freezes down invariably.

Dr. I. P. Trimble.—But the prickly ash our correspondent writes of, is not that of which Mr. Curtis speaks.

Mr. F. D. Curtis.—All of which shows that care should be taken by those who would try the experiment to secure the proper kind of ash, as some is certainly worthless for hedging purposes.

Mr. A. S. Fuller.—The objection to any kind is that it produces so many suckers as to be kept in bounds with considerable difficulty.

BROOM-CORN CLEANER.

Mr. L. Sneed, Frankfort, Ky., desired information as to where he can obtain a machine for removing the seed from broom-corn.

Mr. F. D. Curtis.—The growers in the Mohawk valley break down their corn as soon as the brush is matured, and thresh the seed out with a cylinder filled with small spikes and turned by a horse-power. The brush is laid upon a table in front of the machine, and held by the operator on the cylinder until the seed is stripped off. It is a very simple affair.

Reclamation of Waste Places.

Mr. James M. Bates, Bedford, N. Y., forwarded fine samples of timothy grass raised on land which, four years ago, was considered worthless. He gave the following account of the restoration: It was not boggy and cold; I put in blind ditches filled with cobble-stones around, next to the upland, and run ditches toward the river, two rods apart. These I left open for one year. I then made blind ditches of them, by filling with stones and covering with sods and earth. The land is now hard and dry. When I first plowed it, three years ago, the oxen frequently went in the muck up to their bodies. I can now cart a ton load anywhere over it. I covered the wettest parts with sand, and used horse manure for top-dressing. I think I have gathered at least four tons to the acre. You will observe that these heads are not ripe, only a few of them showing the blow, and some of them are hardly out of the sheath. Many of them were twelve inches long before they were dried. The seed used was the common timothy seed, purchased at the store in our village.

Dr. I. P. Trimble.—I am much impressed with the account of the manner of draining the bog. No engineer could have done it better. Others may learn of our correspondent, and they will frequently find that a ditch around a swamp is sufficient, and that cross ditches are superfluous; an unnecessary expense.

Mr. H. L. Reade.—I question if it is the part of wisdom to use stones for filling in. Good husbandmen whom I have met think it better to leave the ditches so that they can be cleaned out every three or four years.

Mr. F. D. Curtis.—Within a half mile of my place, there used to be a pond where the frogs furnished cheap music for the neighborhood, and connected with this bog-hole several acres of wet land, which had never produced anything under the management of the owners. A new man of enterprise possessed the land and drained the bog, carting the muck, etc., thrown out of the ditch upon the land, and burning it, spread the ashes, and with no manure but this, there grew a splendid crop of corn and subsequent fine crops. The manure obtained paid for the entire cost of ditching. Farmers should not walk around these wet places, but go through them, or hire some one to do so. As a rule, the muck thrown out by ditching a black swamp will pay the ditchers' wages if properly used as manure.

BURNING STRAW.

Mr. William Strong, Kalamazoo, Michigan.—On 999 wheat-growing farms in every 1,000, the whole of the straw can be used with profit. But Mr. Wragg of Iowa says, who last spring wrote, saying that he burned as little as possible, cannot use it at all. Then he sows too much wheat, or keeps less stock than he ought to. It may be he has made both mistakes. If he had given us the average yield of his wheat fields, the number of acres raised yearly, as compared with the whole number of acres under cultivation, it would have thrown much light upon the subject. Now, to show that the straw upon a grain farm can all be used, and I believe with decided benefit to the farm and the farmer's pocket, pardon me for referring to a bit of personal experience. Last year very nearly one-half my tillable land was in wheat, yielding over twenty bushels to the acre; this yield would have been much higher had not considerable of it been stubbed in. The straw made a heavy growth, yet this straw was all used up when spring opened, and there was none sold or burned up; and to-day I have a splendid lot of good manure for the wheat fields and for top-dressing sod land this fall for corn and other crops. Do not think this manure is simply rotten straw, for it has been used as bedding for beef cattle, horse stables, sheep and cattle yards, hogpens, and every place where bedding was needed day and night. This year I have less straw, and am sorry that Mr. Wragg's straw-stacks are so far off, as I would be glad to save him the trouble of burning them. The day is coming when straw-stacks will not be burned or left in the fields to rot. I know that straw-burning is all too common, and perhaps necessary when a man has ten acres of grain to each head of cattle on his place. But what I urge is that straw-burning always proves a disproportion between animals and grain fields. This one-sided farming is bad farming, and if Iowa is burning staw it shows that Iowa ought to fatten more steers.

CURE FOR CABBAGE WORM.

Mr. Samuel C. Wait, Gouverneur, N. Y., had his cabbage patch attacked by the pest above named, and for a time he feared he would be obliged to get through the coming winter without the annual allowance of sourkraut. I applied salt dissolved in water, in the proportion used in curing hams, or in curing beef for drying. Indeed, I used ham brine and beef brine that had been used. It will do no harm to the plants, nor unfit the head to be eaten. Dry salt is of little value, and that little is owing to the little dissolved in dew or rain. I poured into the center of the plant three or four spoonsful, less or more, according to the size of the plant. Dry ashes are no better and no worse; wet ashes or ley would corrode the plant, according to their strength. The cabbage worm, or larvæ, are green, only because their food is green. A medium sized grayish white butterfly deposits the eggs on the under side of the leaf, from which they hatch. They attack the inner tenderest leaves first, and at the edges and top. The top will look as though cut off with a knife. They never begin at the bottom of the leaf. The innermost leaves are their daintiest dish. If the inner leaves are cut down close, the plant is gone. No more leaves will put out.

BLACK LOCUST.

Mr. George Copeland, Dresden, Ohio, would grow this tree, and asked how to prepare the seed and when to plant it.

Mr. A. S. Fuller.—Gather the seed in autumn, and clean them from the pods and pulp. Then sow immediately, or mix with sand, and bury them in the open ground until spring, and then sow. Locust seed grow almost as readily as wheat, if never allowed to get dry. If seeds have to be purchased and are dry when received, pour scalding hot water over them, and allow it to remain until cool. Then drain off and mix them with dry wood ashes in sufficient quantity to take up the moisture on their surface and prevent their sticking together when sown.

WORTH OF WOOD ASHES.

Mr. S. M. Edwards, Macon, Miss., wrote to express the opinion that the Club does not overrate the value of ashes. He has used them for the last thirty years, and had made an almost barren spot a fertile garden by their use in compost. That he gets the storekeepers in the town, that he and others supply with wood, to save their ashes for him. He says that he worked early and late, which no doubt helped him to make his place fertile. He composts by using large, tight hogsheads; puts in barn-yard manure, leaves and ashes; fills up with these, and then lets it stand in the weather until it is ready to use. Also used ashes alone with great benefit in his garden. His vegetables do not fire, and no worms ever touch his cabbages. He prefers them leached, as he makes his own soap. Let us have the experience of others on this subject.

ON SOILS AS INFLUENCED BY AIR, HEAT AND MOISTURE.

Professor J. A. Whitney.—The direct object of all tillage is to enable the roots to more readily derive from the soil the ammonia and soluble mineral substances required for the growth of plants. Most minerals exist naturally in the soil in sufficient quantities and in a sufficiently soluble form to meet the demands of vegetation; but this is not the case with potash, ammonia, phosphoric acid, and one or two others. The two former are especially required while the stem and leaves are growing; the latter needed most when the grain begins to fill with milk and while it is hardening to ripeness. With regard to the potash and phosphoric acid, there are two ways of obtaining or rather providing them in the soil. One, the common resource of manuring, supplies the substances from extraneous sources. The other, nature's method, consists in decomposing the atoms of mineral matter containing the plant food through the action of air, heat and moisture permeating the soil. In proportion, therefore, as we can do this, we enable the soil to increase its crops in the same manner as if potash and phosphatic manures, ashes and bones, had been applied. This is constantly done on all soils. For example, an acre of ordinary wheat soil, ten inches deep, would weigh somewhere in the neighborhood of 1,000 tons, and according to the estimates of skilled chemists contains, at any one time of potash soluble in water, about seventy pounds. A good crop of hay would take more than half of this from the soil, so that the land would be wholly exhausted in two seasons, if no provision for a new supply was provided. But while the crop is growing, and through the autumn and spring, while the field is apparently lying idle, the air permeates the soil, and by its action on the humus or buried vegetable matter, causes it to decay. This evolves carbonic acid, which is absorbed by water, and this sour or carbonated water acts far more powerfully than pure water to dissolve the required minerals from the strong particles of granite, lime and felspar. The potash, and whatever other elements of plant food they contain, is liberated in a condition fitted for being taken up by the small tufts called spongioles at the ends of the roots. These are appropriated by the plant and carried into its system. It is evident that this process will go on spontaneously and continuously whenever the air has access to the soil in the presence of a fair degree of moisture and of warmth sufficient to promote decay. This access of air has, moreover, another result in affording nutriment to the plant by its indirect function in providing means for the furnishing of ammonia. The decay of the roots of a preceding crop and of other organic matter produces *humus* in the soil, which has a great power of absorbing ammonia mechanically, as a sponge absorbs water, and humic acids which combine with ammonia to form non-volatile compounds. The ammonia from the air, or from the decay of animal or other manurial substances in the ground, is thus fixed and held until seized upon and assimilated by the growth of vegetation. As the supply of plant food is thus increased the roots multiply, in order to seize upon it, and the ground is more thoroughly permeated by them. When these roots decay the humus is augmented, and the action of the air, of heat and moisture being continued, the process mentioned keeps on also, and the provision for future crops is made in a continuous round of slow but certain chemical action. In most instances, however, this process is too moderate to supply plant food for very heavy crops, and hence the necessity of manuring to obtain the latter; but we see that the quantity of manure required to secure a given yield from a soil will diminish in the same ratio that we enable the soil to help itself. On this principle an English farmer announced that the plow and harrow are true fertilizers and stirring is manuring. Herein lies the success of deep tillage in soils not naturally pervious. It stands to reason that, other things being equal, we can get twice as much soluble mineral matter from, and fix twice as much ammonia in, a thousand tons of soil as in 500, or, in other words, by stirring the soil ten inches deep instead of five. A deep soil, whether so naturally, or made deep by artificial means, is, indeed, the only one in which the triple agencies of which we are speaking can act to advantage, for it must be remembered that they must bear a certain relation with each other to insure fertility. Air without moisture and heat would give simply a cold sponge of earth, in which no seed could germinate, and from which no plant could draw nutriment. Moisture without air or heat would allow the mold to grow a low order of plants like mosses; and heat without air and moisture would show only a hard baked clay or an arid sand. But when we have all in due proportion the soil is enabled to remain at a temperature of about sixty degrees; there is water enough in it to dissolve the minerals and absorb the ammonia and its compounds, and to convey these constituents of plant food into and through the roots, and their is air enough to permeate the whole without making the ground too porous. If the soil be shallow upon a dense subsoil, the water instead of percolating downward and filtering away from below, mainly evaporates from the surface, and this evaporation, as is well known, reduces the temperature of the soil. The heat withdrawn by the vaporization of one pound of water is equal to that required to raise the temperature of 132 pounds one degree Fahrenheit. The clinging together of the particles of the soil if stiff or clayey, of course impedes the access of air, the penetration of the roots, and the dissolving of enriching matter from insoluble particles. The immediate consequence of this is, that the soil is too cold in early spring for the sprouting of seed; and unless the sowing or planting be delayed, the seed is liable to rot in the ground. The plant cannot assimilate the food existing in the soil because its stunted roots cannot reach it, the production of humus is diminished, and so, consequently, is the future decomposition of mineral matter, and of course the productiveness of the fields is small compared to what it would be if its elements of fertility were placed under conditions where they would be more readily available to the plants. This matter of causing surplus water to pass off from below instead of evaporating from the surface is one of great importance. In Scotland the introduction of drainage, besides increasing the yield of crops caused the harvest to come a fortnight earlier than it did before, and as may be readily understood, deep tillage is, in some respects, a system of drainage in its manner of withdrawing excess of moisture. The difference between the temperature of the earth and air is always greatest in spring, because having been cold the whole heat of the soil must be derived from the sun. With a soil so deep that the surplus water percolates through it instead of evaporating from the surface, the heat of the sun's rays is wholly utilized in warming the land instead of being withdrawn from the latter, as previously explained, by evaporation. The warmth of the soil, and, of course, the earliness with which it may be planted, depends therefore as much upon its condition as upon the weather. The looseness and depth which permits this percolation of water, also at the same time permits access of air, and in soils containing iron presents a curious but detrimental chemical reaction. Under ordinary conditions, oxyd of iron is in the form of simple red rust, a peroxyd innocuous to vegetation, but when this is buried in contact with decaying matter or humus without access of air, this humus needing oxygen in the process of decomposition, and being unable to obtain it from the atmosphere, takes it from the harmless peroxyd and converts this latter into a protoxyd hurtful to vegetation. Furthermore, the power of a deep soil as compared with a shallow one, to resist the drouth is well known. This arises from the capillary action which enables the water to rise from below (where it has lain too far down to be dissipated by ordinary evaporative action), as fast as withdrawn from the upper soil, either by the plants or by exhalation from the surface. In fact, the principle of this is the same as the rising of oil in a lamp-wick as fast as drawn off by the flame at the top; but where the surplus water, instead of being stored in the form of moisture in a mellow subsoil, has either been drawn away from the top of the ground, or, as is sometimes partially the case, run off between the surface mold and a hard subsoil, there must necessarily be none to rise when the parched subsoil thirsts for more. But this is not all; a deep and mellow soil will, other things equal, be found to have a greater power of absorbing moisture from the atmosphere and of retaining it. Another item is to be considered in this connection; the darkening of the soil by the increase of humus or decaying vegetable matter, which is directly dependent upon the extent to which roots grow and permeate it; and this is in the ratio that the soil is deep, moist and warm. The value of a dark soil, from its greater capacity of absorbing heat, is well illustrated in the well known experiment of Giraudin, having reference to the ripening of crops. He found by actual trial that "on the 25th of August of a particular year, twenty-six varieties of potatoes were ripe on a very dark-colored, sandy, vegetable mold, twenty on an ordinary sandy soil, nineteen on a loamy soil, and only sixteen on a white calcareous soil."

What has been urged is only an array of strong scientific reasons why soils must be deep, porous, dark, mellow and warm. Every farmer knows this who can year after year cradle twenty-five bushels of wheat or dig 200 bushels of potatoes from one of his acres. The grand error of all our plowmen is that they skim too great surfaces and get what they can from four inches at the top, instead of going down to the strength and fatness that lies in the six-inch stratum next below the four.

Adjourned.

August 30, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

This session was mainly devoted to descriptive accounts of various parts of the country and their agricultural development. Foremost among these papers was the report of one of the special committee that recently visited California, Prof. James A. Whitney, which follows:

AGRICULTURE BEYOND THE MISSISSIPPI.

The delegation of the Club that went on a tour of observation across the western half of the continent, can say in general that we were fortunate in receiving attentions from men of the first intelligence on rail-cars, and in various towns and cities. To Senator Williams of Oregon, Mr. Theielson of Iowa, Apostle Smith, and others of Salt Lake City, Mr. Shaw, Prof. Carr, Mr. Warren, Mr. Dewey, Mr. Howard, and others in San Francisco, and Father Varsi of the Santa Clara College, we express our acknowledgments for valuable facts communicated, and for civilities shown. In our studies of the great plains we received important ideas from conversations with Mr. Meeker and Gen. Cameron, the leaders in that remarkable and prosperous settlement.

Taking Chicago as a starting point, the traveler passes through the prairies of Illinois to the borders of Iowa. Here rich and wide-spreading farms appear; great fields of corn and wheat hint of full granaries and happy homes. As one goes further toward the western boundaries of the State, cultivated lands grow fewer until within about 200 miles of Omaha a fine rolling country appears, covered with short grass, and, where turned up beside the railway track, showing a black soil rich as the muck used for composts in eastern barn-yards. Here the expanse is broken by no signs of tillage, except where, at rare intervals, some emigrant has pushed to the far frontier and dotted the prairie with a few acres of yellowing wheat. Few running streams, so that water, if obtained, must generally be drawn from wells; no timber for fences, but partition by ditches and ridges of prairie sod; no near markets, so that for years the reward for hard work would be food and shelter only; cold winds and deep snow in winter; these are the drawbacks to the settler who builds his cabin in western Iowa. On the other hand, the soil is fertile as any soil on earth, and mellow and deep, for on the alluvial of the Des Moines corn has been known to send its roots to a depth of eight feet, and whatever the result upon the land, it will yield bounteous crops for years without manure. There is abundance of bituminous coal in the State for fuel, the annual harvests will furnish food enough and to spare, and frontier life requires none of the expensive surroundings incident to older settlements; more than all, population thickens and creeps continually toward the borders of the great desert, and the poor man who raises the roof-tree of his dwelling on a section of railroad or government land to-day, may find himself wealthy in ten years from now. These are the pros and cons which every man who proposes to move to this region must consider. The same advantages and disadvantages exist in the neighboring portions of Nebraska; for westward, 200 miles from Omaha, the general characteristics of the country are the same, the only exception being an apparently greater scarcity of water, which can be remedied by wells. Here and in Iowa will be the field for a more extended use of agricultural machinery than elsewhere on the continent. Already the method pursued in the settlement of tracts of land in Nebraska is what would be an improvement upon the best system of English tillage, if steam power were used in place of animals. The settlers locate; build houses of adobes, or sun-dried brick; have their prairie-sod broken up by companies organized to do this work and nothing else, and who own scores of plows and many teams of oxen. The seed being sown, and in due time the harvest ready, other companies, whose assets are horses and reaping machines, cut and garner the grain. The time will come when steam and not oxen will propel the plows; and the most systematic application of organized labor and industrial skill will be seen on these fertile prairie lands.

THE GRAMMA GRASS.

Looking from the car window as he journeys west, the traveler finds the prairie grass change gradually to the "bunch" or "gramma," for he has passed the region where snow falls, and has reached a country where the grass dries in winter and makes itself into hay. There is pasture, therefore, the year round; and this is so nutritious that worn-out cattle turned adrift on the plains in a few months are fat and fit for beef. It is a country where grazing is now the chief industry. How far it can be made productive in grain is an open question, wholly dependent upon the feasibility of irrigation, and one the solution of which is not likely to be attempted until the fertile prairie region to the eastward has become so thickly settled that its farms are held for high prices, and emigrants are compelled to seek cheaper homesteads in the pasture grounds beyond. To this change, however, from a pastoral to an arable cultivated region, there is interposed the scant supply of water, the chief source being the Platte, which, although capable of irrigating a large tract, would require to have its waters elevated by steam or other power to a height of many feet in order to secure the head requisite for its distribution to the land.

THE GREAT BASIN.

Leaving the low country on the Platte, the train bears the traveler past Cheyenne, through the southern edge of Wyoming, and anon gradually up the slope of the Rocky mountains, until at last, at a height of 8,000 feet above tide water, he commences to descend into the Great Basin, through which run spurs and minor mountain ranges. The descent is far from steep or sudden, for the track runs upon the elevated table lands until the western declivity of the Wasatch range, looking toward the valley of Salt Lake, is reached. Here the train moves without steam down a grade of seventy feet to the mile, and one realizes for the first time that the Rocky mountains have been left behind. While passing through this region the sight of snow-capped mountains becomes familiar to the eye, the never-melting drifts gleaming white above the bare and rugged sides. Nothing but moisture is needed to clothe these desolate slopes and wide wastes with the verdure of grass and the opulence of grain. This is proved by the luxuriant growth wherever a spring or trickling stream has found its way above the ground. We saw on the slopes of Mount Aspen, where oozing streams slaked the surface of a few acres, a man cutting down the ripe grain with a mowing machine. Still further on, toward the Salt Lake valley, are spots where hay and grain are grown. In like manner, beyond all this, on the opposite side of the desert, at Truckee, for example, the stream of the same name was bordered at intervals with cultivated fields, and, as if to show that even in the most unlooked-for places the same result will come from the same conditions, there was noticed at the base of a gray foothill, near Stone House station, a narrow strip of grass fed from the overflow of some subterranean crevice. Near Reno, also, a field flourished by irrigation bore an abundant crop of ripening grain, while to its very edge, on the opposite site of the fence, came the soil of the desert, dry as ashes, and clothed with the ubiquitous and useless grease wood. Wherever mountain streams can be conducted to water the land, it may be made to yield bountifully, and even in the very desert itself the sinking of artesian wells would make the alkaline soil rich in harvests. These wells in many portions of circumjacent territories are destined to play a most important part with reference to tillage. This is especially so in Colorado, which appears, in its situation and geological characteristics, to afford the greatest promise of success. The practicability of this method of obtaining water has been proved by diversified and extended experience. Artesian wells are said to have been used for irrigation in the neighborhood of Los Angelos, in California, for 200 years, and there are now 700 of them in the county of Santa Clara. Greater evidence of their availability, even in extremely arid regions, is found in the success of French engineers in Egypt, who by their aid have made palm trees and millet grow in the sands of Sahara. The alkali country, a vast region of gray and arid soil, impregnated throughout with carbonate of soda and bearing only two kinds of plants, the grease wood and the sage bush. The most dry and dusty portion lies beyond Ogden; but much of the same character of country is found for one or two days' journey upon this side. Ogden, the point of junction of the Central and Union Pacific railways, is also the station on the line nearest to the capital of the Mormon settlements, with which it connects by the Utah Central.

SALT LAKE CITY.

Approaching the Mormon city the traveler passes through a level valley, the great Salt lake on the right, the mountains lifting their rugged and snow-clad peaks on the left. The fields are inclosed by slight fences curiously made by throwing up ridges of earth, driving stakes in the top, and weaving brushwood between the stakes. The fields are irrigated by thin streams let on at intervals from channels extending from reservoirs at higher levels, and fed from the mountain sources of supply. When nothing happens, the crops of corn, wheat, and other produce are very thrifty, but frequently the grasshoppers devour the young plants, and some fields this summer have been planted three or four times in vain. Notwithstanding the abundant yield frequently obtained from the soil, and the facilities for easy irrigation, this isolated district does not seem to offer to settlers any advantages at all comparable to those afforded by the pasture and arable lands to the eastward. That it has been settled at all is due to the fact that its inhabitants have been willing to pay a heavy price for immunity for their peculiar usages. Surrounded by what until recently were unexplored and almost impassable deserts, and placing its inhabitants beyond the reach of the Christian sentiment and of civil law; the valley afforded shelter to a community that could have found asylum nowhere else. Its people passed hundreds of miles of fertile grain and grazing lands to reach the dry valley of Salt lake, and to carry out the theories of a polygamous creed. In doing this, for every dollar of wealth created they have expended five times the labor it would have required in other portions of the country, and in their works of irrigation they have forestalled necessities that can exist when all the arable land to the east and west shall be occupied by a dense population and convenient markets. Their system of irrigation is remarkable only for the extent of ground it covers. The system itself is centuries old, inferior in the skill required in planning to the bedwork system in use in Europe, and showing in its works simply examples of patient ditching. Salt Lake city itself is embowered in shade trees, of which there are many thousands. Our conclusion on Mormon industry is that a wild delusion has enabled an able but grasping leader to organize and push a system of tillage that shows brilliant figures, but that a Christian system and a republican government will in their results as far transcend the exploits of polygamy, as the sanctity of an English home shines above the lust and the hate of a Turkish harem.

Beyond the Nevadas.

Leaving behind us the multitudinous rivers and the alkali wastes, we passed into the timbered region of the Nevadas, which supply lumber both east and west for building and other uses. From this, down a steep grade and in sight of magnificent scenery, we emerged into the valley of the Sacramento, forty miles wide, and the finest grain-growing section of California. The district bordering on the ocean from twenty to thirty miles wide, is humid and comparatively cool; and here the great dairies, some of them including from 600 to 1,000 milch cows, are found. Further inland the atmosphere is drier, and the weather commonly more hot, affording every advantage for raising grain. The Sonoma valley has its hundreds of acres in grapes, the vines cut low in bushy form, as was also seen in some scattered vineyards on the Sacramento, and as is the practice in Germany and France. South from San Francisco some fifty miles, Santa Clara has its marvelous orchards of varied kinds of fruits, the tree-roots nourished by water from Artesian wells distributed to different parts of the gardens. Grain, wine and fruits are the staples which California would export in the greatest quantities were transportation less costly than it is. The grain in the form of flour and the wine duly bottled for use are already known in eastern markets, but the carriage of fruit is too costly for profit. The fruit of California can only establish permanant branch of trade when the practice of drying it for market by improved processes shall be largely adopted. For this purpose some of the methods proposed in the east of drying by currents of hot air or by the application of heat in vacuo would prove profitable, but the best will be the adoption of some economical means of applying the hot sunshine of California to the purpose.

CALIFORNIA TILLAGE.

As previously intimated, the modes of tillage are quite different from those obtaining on the Atlantic slope. The land, plowed once to the depth of three inches, very often by a gang plow running on wheels, and furnished with a seat for the plowman, is sown; in due time the crop is harvested; later, when the rainy season comes, whatever of scattered grain has fallen the previous year takes root and grows, and another called the "volunteer" crop, is taken from the ground. Frequently, indeed, the farmer runs a harrow lightly over the same field, and, without reseeding, waits for another volunteer yield, which is commonly about one-half as large as the first. When the grain ripens, harvesters, similar to those used in some parts of Iowa, Illinois, etc., and known as "headers," are used to sever and collect the heads from the straw, the latter being left standing where it grew, while the former are carried to the thrashing machine. The thrashers are commonly set up in the open field, and are run by portable engines; we saw, however, one sweep-power, operated by six horses walking around in a circle. The grain thus thrashed in the field is put in sacks, which are piled up by hundreds in the open air, and covered over with a little straw. Here they may lie safely until the rainy season approaches, before which time, however, the grain is generally carried away to mill or market. The clear weather of the harvest season makes possible a system of gathering the grain more expeditious than this, and available in no other part of the world. Those familiar with eastern husbandry know, that after grain is fully ripe, a few days is sufficient to make it shell badly, and frequently enough, also, to cause it to crinkle down, so that much of it lies too low to be reached by the reaper; consequently the cutting must be rapidly done, or a considerable per centage of the yield is lost. Here nothing of the kind occurs. The fields grow yellow, and still for weeks the straw stands upright, and no more kernels drop than is required for the voluntary crop of the succeeding year. No part of the country is so well fitted for the use of a good header and thrasher.

STEAM PLOWING IN CALIFORNIA.

The success of steam tillage in England has been founded upon the cultivation by its agency of bog and stiff clay lands, that by ordinary methods could not have been tilled at all. In like manner, the chief advantages of the system in that portion of the United States east of the Rocky mountains will come from the turning of deep furrows.

which practically shall add the benefits of underdrainage to those of thorough surface tilth. In California the latter condition only requires to be met, for the subsoil is believed to be sufficiently loose already to subserve all the requisites in this respect of good farming, and hence the mechanism needful in steam culture in other parts of the world is no standard by which to judge. The aims of California inventors have been to produce a machine that will stir the soil to a depth of three or four inches only, and Californians are sanguine that on their fields the first successful American steam plow will be made to operate. Two systems of construction, both involving the use of a traction engine and rotary cutters, have come very prominently before the public, and have cost their projectors considerable sums of money in experiments. One of these, the Standish plow, was tried some time since with alleged satisfactory results, but the inventor having devised some modifications and improvements upon his first plan of construction, the original machine has been laid aside, and a new one is now being built in Boston, Mass. In this the soil is disintegrated by the action of a series of forks or spades, each rotating upon a vertical axis at the rear of the machine, and actuated by suitable gearing connected with the driving axle of the latter. The other, that of Mr. Locher, of Oroville, has at the rear of its main frame a horizontal shaft, furnished with radial mold-board and shares. These are modeled upon the ordinary mold-board form, except that each is shaped to move in a curvilinear path instead of a straight one. The rotation of the shaft during the forward movement of the machine brings the plows in constant succession into the ground by their downward motion in front of the shaft, and lifts, pulverizes and inverts the soil by their upward movement during the opposite half of the revolution.

INDUCEMENTS TO SETTLERS.

With a climate unrivaled, even under the skies of Italy, and a soil that yields its harvests to the slightest cultivation, and mineral resources apparently inexhaustible, one might suppose that California offers superior inducements to settlers; a supposition true to some extent at present, and likely to be much more so at no distant period, when certain industrial and agricultural problems shall be nearer solution than they are now. With all its natural advantages, California has its drawbacks to that class of emigration upon which the progress of all new countries must depend, that of hard-handed men, who, with little or nothing more than the immediate results of their own labor, seek to build up homes for themselves and their children. Limited markets exist for a great abundance of farm produce, and consequently business is dull. Tillage is devoted mainly to a few great staples, and the numerous smaller but essential branches of agriculture, which in the aggregate support a large per centage of the farming population in the east, are apparently unknown and unappreciated.

The portions of the State now devoted to tillage or pasture are held in large ranches, for 600 or 800 to as many thousand acres each; and until the division of these into smaller farms shall be well under way, the land system alone will tend strongly to discourage the formation of an intelligent and independent but hard-working yeomanry. But the difficulties referred to will sooner or later be ameliorated; but in the mean time they may prevent the State from keeping up in increase of population and progress of material development with some of the territories midway between the Pacific and Atlantic coasts. It may be noted, however, that, to a class of emigrants, these objections do not apply. A young man, with some money and more than average education, will find the way clear before him. He will be above competition with the Chinese; he can put his money in bank, at ten or twelve per cent interest, and, by working a year or two at some salaried occupation, may become familiar, without loss, with the peculiarities of the country, and, doing this, can scarcely fail to find opportunities for combining his capital and labor in a way that, with good habits, will lead him to wealth and eminence. To the happy worker, whose dream of rural bliss is a picture of old Syrian felicity; who would see his flocks browsing on the hills, while his wheat nods over broad valleys; who would reel his silk cocoons, while great purple clusters load his vineyards; who would have great store of oil and wine, and gardens rich with torrid splendors, and perfumed with rare flowers, those sunny and fertile valleys of the far western coast have attractions beyond any other portion of the American soil.

COLORADO.

The new town of Greeley, visited on the return trip, is situated on the Denver Pacific railroad, about midway between Cheyenne and Denver. The settlement, when we saw it, was about ninety days old, and embraced between 200 and 300 dwellings already erected, and still more in process of construction. Some of them were of wood, and others of adobes, still others of grout, which is the cheapest, but the least ornamental. Among the buildings were a hotel, a post-office, a bank, and a public hall. The land, divided into town lots, and into farms of forty and eighty acres, seems fertile when irrigated. This is done by leading upon it the waters of the Caché la Poudre, through a canal ten miles long, already finished. The town portion of the tract is planted with hundreds of young trees, which appear to be doing finely, the soil at the roots of each being moistened daily by opening a slender channel leading from one of the ditches connected with the canal. A canal larger than the present one is in contemplation. It is designed to irrigate an outlying portion of the district, and will furnish work to the settlers during the coming winter. This work will be paid for from the fund set apart for the undertaking, and will enable them to meet the expenses of supplies from the east, which, from the lateness of the season when operations were commenced, will have to be depended upon for a few months to come. Such are the salient features of the three months' history of the enterprise. Considering that the members of the community moved into a region where climate, soil, and modes of cultivation were all unfamiliar, enough has been already done to insure the success of the colony, and that it will prove the model and forerunner of others that will dot the plains of Colorado with prosperous settlements. Colonization is, indeed, the only promising system by which most of the unsettled agricultural lands of the territory can be brought profitably under cultivation. All such lands require irrigation, and for this the water must, for the most part, be drawn through great canals from rivers like the Arkansas, Platte, and the Caché la Poudre, which can only be done to advantage by associated effort, and it is far the best that the distribution of the water should be under the control of those who till the soil it irrigates.

Colorado, lying thousands of feet above the sea level, has a dry, clear and healthful atmosphere. No snow falls except for a few days in the year in the northern part and in the mountains, where it forms the remote source of the water supply to the plains below. The labor of irrigation, always essential where crops are grown, is partially counterbalanced by the fact that irrigated land requires less tillage. Most of the fertile land of the territory, however, must always be devoted to grazing, for the reason that the available streams, even at the utmost, can only water about 4,000,000 out of 34,000,000 acres of fertile land in the territory. It is possible that eventually this proportion may be changed by the use of Artesian wells. There is much reason to believe that this is practicable; for Artesian wells simply afford outlets for water that, passing down through rock strata from higher ground, as from mountain tops, accumulates lower down between the strata, and is forced up through any opening with a pressure proportioned to the height of the source from which it is primarily derived.

To settlers, the advantages of colonies, taking with them the comforts, conveniences, and usages of civilized life, are obvious, and they should be availed of by all who seek, under the rainless skies of Colorado, to carry on the cultivation of the soil. To those who prefer to proceed independently, it may be said that, although there is little or no demand, as a rule, for day laborers, yet steady farm hands command, we were informed, in the neighborhood of thirty dollars per month and board. A person expecting to reach the country a stranger should have some money ($100 or $200 dollars), to keep him while waiting his opportunity. This may come, if he can produce good evidence of character and good standing at home, in a chance to cultivate land on shares, teams and seed furnished, and frequently credit for provisions and necessaries in the interval between seeding and harvest; or it may come in a chance to herd cattle on the plains on shares. This latter is a custom arising from the necessity of continually watching the herds. The arrangement commonly made is for the herdsman to take say 100 head of stock, and at the end of three years return the same number and kind and one-half the increase. As the average annual increase of stock in the territory is sixty per cent, it will be seen that there is much profit in cattle-raising.

As a summary of our observation in the west, I think the members of the Club who have had the pleasure of viewing this remarkable country will agree with me in these conclusions:

First. The region east of the Rocky mountains and west of the great rivers is by no means a waste. While it may not be equal to Iowa in its power to respond to tillage, is admirably fitted for pastoral industry, and can for generations furnish flesh, wool and leather to the dense populations in the center of the great valley.

Second. The *soil* of the central desert is not, properly speaking, sterile. The region is treeless and bare, not because the earth cannot supply plant-food, but because there is lack of water with which to render that plant-food soluble.

Third. California is so extraordinary in both soil and climate as to give contrast rather than comparison with all eastern agriculture, but it is a region capable of sustaining a very numerous population, and supporting an immense and diversified industry. Its facilities for producing wool, wine and wheat are equaled nowhere. What she needs is that available tracts of 100 acres each be offered at fair rates, and owned by men who work on them from January to December.

Fourth. Considering all the inducements held out by the mighty west, we have no word of condolence for the strong young man who crowds in where there is no moral certainty that he can earn honest bread. Those plains, slopes and valleys call aloud to whatever of pluck or manhood there is in Young America to come out and conquer their roughness, develop their fertility, and create happy homes for themselves and give food to millions.

Mr. Frank D. Curtis.—While I can indorse all the statements in Mr. Whitney's report, for which I and the Club thank him, I wish to enter a protest against those sentences which, turning aside from farming, comment upon the morals of Salt Lake. Those strictures may or may not be true, but polygamy and deep plowing have nothing to do with each other, and I don't like to see matters mixed in that promiscuous way. I am satisfied that the Mormon plowing is shallow, and that is what I have against them.

The Chairman.—In listening to Mr. Whitney and praising his paper, we do not indorse plurality. President Young and Elder Smith can have their harems and be happy. All we officially take note of is their irrigation, and their tillage, and their industrious ways. If it is true that Brigham doesn't stir the ground deep, in our view, that is more against him than his fifty-four children and his sealed wives. We will hear some of the other excursionists on this point at future meetings.

MARKET GARDENING AT THE SOUTH.

Dr. A. Oemler, Savannah, Ga.—The matter I propose to present to you is the profit of trucking for the northern markets in the vicinity of Savannah. I am here in the hopes of bringing about the organization of a stock company, or entering a copartnership with the object of the cultivation of truck on an extensive scale in a locality where that industry is yet in its infancy, and where those who first embark in it, supplied with the elements of success, will reap the richest harvest. The vicinity of Savannah is undoubtedly the most extreme southern point where vegetables for your consumption can be profitably raised, and whence the produce can be received at Boston, New York, Philadelphia and Baltimore, in good marketable condition. Some articles are reshipped at Savannah from Florida, it is true, but ours will always bring the fancy prices, for the produce commission dealers among you, if any there be, will bear me out that the produce from Florida arrives too often in bad order to be profitable to the producer. Before they have proceeded any further northward than Savannah, they often already require overhauling, or are altogether unfit for shipment. Truck raised near Savannah are, as regards the prices they command and earliness, like the produce of the hot-bed. Fourteen large steamships now plying between the ports of Savannah and the four already named are more than adequate for the transportation of our crops. The lands heretofore devoted to the cultivation of truck in the vicinity of Savannah have been mostly of a low, tenacious, inadequately drained and therefore cold character. Doubtless, from your knowledge of the topography of Savannah, this is known to many of you to be true. The appropriation for the drainage of the city, now under consideration, will be large, owing to the low character of the surrounding country, and that, for hygienic reasons, it is to have an outlet considerably below the town. Bermuda, although about ten miles north of Savannah, owes the early maturity of its crops of tomatoes, onions, potatoes, etc., to the warmth of the waters of the Gulf Stream, and to its open exposure in the ocean.

Situation, I think, is of more importance than soil, for while one can be ameliorated the other is incurable; but for complete success both should be of the most favorable character. In some localities a running stream not liable to refrigeration will have a beneficial effect on its vicinity; how much more so, therefore, the ebb and flow of the ocean, and of the numerous salt rivers and creeks in the vicinity of the sea islands.

The moist condition of the sea air, and the virtue of the salt contained in the soil, have also a favorable influence during drouths.

If I am not mistaken in my premises, the crops on the light, warm, sandy soil of Bay Ridge, L. I., should be earlier than those under the same latitude in the interior of New Jersey.

The lands which I propose to devote to the purpose, while really under the same parallel, are virtually more southern, for they combine all the conditions enumerated and are adequate in area. The samples of soil herewith submitted have intentionally been taken from fields which have never been fertilized but by the hands of the Creator, and have mostly been lying fallow since 1856.

The failure of so many northern men who had engaged in planting southern lands is due to the fact that they would not modify their practices so that they would not clash with the accumulated experience of southern planters. While we do not contend that agriculture in its wider range is not better understood, and the general farm management far superior at the north, we do think that climate, soil, and difference in staple crops and other contingencies should be sufficient to modify views acquired in more northern latitudes.

The varieties of vegetables best adapted for shipment to your markets, in the order of their importance, are tomatoes, cucumbers, sweet-potatoes, melons, squash, peas, beans, Irish potatoes, cabbages, lettuce, and radishes. With the present labor I should plant none but the first five on Wilmington Island, but should endeavor to produce those in perfection. One article not enumerated I should like much to try, as it grows in its wild state among weeds and bushes over nine feet high unmanured. I mean asparagus. I have some seedlings coming on, however, and shall test it.

The earliest possible production of tomatoes and sweet-potatoes requires the employment of glass, as it is important to put out plants of the former of considerable size. One of the chief enjoyments of gardening consists in overcoming difficulties, and in outstripping competitors in the race for the earliest maturity of crop. The greatest desideratum is to have the plants possessed of the greatest tenacity of life, strong, sturdy, and as woody as possible, as the danger of injury from frost and drouth is in direct proportion to tenderness and succulency. For these reasons, as our climate is not severe enough to require bottom-heat, cold frames and mats, or any other opaque and non-conducting covering, is preferable to hot-beds, as the latter would induce too rapid, luxuriant, and succulent vegetation. Having attained the desired quality of plants, the next thing is to transfer them to the open ground at as early a date as the season will permit with the least possible injury to the roots, so that there be no interruption to growth. The only proper method is to have had them growing in flower-pots.

During the past season, not having enough glass, I substituted a covering of cloth to which I had made an application of a mixture of sugar of lead, linseed oil and rosin, thus rendering it water-tight and less opaque; and, as a substitute or makeshift for pots, I prepared open boxes of crate material, which I sank into my cold frames, each holding thirty-six plants, or 144 plants to each sash. These boxes I carted into the field at planting-time, and with a mason's trowel I cut out the plants and put them in the ground with as careful handling as possible. Of course, all intervening roots were cut, and, as they only take up nourishment at the ends, growth was interrupted until the renewal of root spongioles. There is no removal of spongelets in pots, and the cramped condition of the roots has the further advantage of predisposing to the formation of flowers.

Peter Henderson, your most successful market gardener, says of the profit of gardening: "This is rather a difficult, if not a delicate matter to touch, as the profits are so large in some instances as almost to exceed belief, and so trifling under other conditions as hardly to be worth naming. These latter conditions, however, are generally where men have started on unsuitable soils, too far from market or without money enough to have ever got thoroughly under way." That they can be made very large where the gardener has the elements of success at command, I hope to be able to prove. Please bear in mind that Mr. Henderson's figures apply to the close crops of his garden, and not to those of the open field. For the same acreage he would require about six times the amount of labor and manure at least. He reports annual receipts of $1,500 to $2,000 from four acres of tomatoes. His plants are set 3x3. I find 4x5 the proper distance, and he therefore requires 644 more plants on one acre than I require for two. His four acres demanded 400 sashes. At the distance my plants stood in the frames last year these sashes would have covered plants enough for twenty-six acres; but I would prefer to widen the distance and allow each plant 7.9 square inches more room than they enjoyed last year, and then I would have a sufficiency for eighteen and one-third acres. Sashes and plants are of more importance to me than land, as I have more of it than I can plant. Mr. Henderson has calculated his receipts per sash; eighteen and one-third at a yield actually obtained last year would amount to $10,076.10 or $25.19 per sash. Notwithstanding inadequate means and the fact that I have never known the first fruit to have suffered so severely from the ravages of the tomato worm, not the larva of sphinx Carolina, but that of a small Phalaena, which lives upon the interior of the fruit. The account sales of the first five pickings of only thirty-one boxes (bushel crates) will show a gross receipt of $221.50 from the three-quarter acre supplied with plants from those open boxes already alluded to, and during the entire season this same three-quarter acre yielded at the rate of $549.66 per acre, exclusive of some early ripe fruit sold in Savannah at fifty cents per quart. At the distance Mr. Henderson puts his plants, the acre would have turned out $1,250. The shipment of June 9th, the first to that port from Savannah home production, sold at an average of $8.40 per crate. Under better auspices I could do at least as well on say fifteen or fifty acres, and at the same price 700 boxes at a single shipment, $5,880. The first five pickings from fifty acres, at the same average price obtained for the thirty-one boxes, would have yielded $15,026.50, extending only during a period of twelve days, and for the entire season fifty acres would have amounted to $27,483; and these estimates, be it well remembered, are based upon conditions by no means satisfactory. It is presumable that, whereas single shipments of 8,000 boxes are made to New York alone from Norfolk, the comparatively small quantities I allude to, when distributed to the ports of Boston, New York, Philadelphia and Baltimore, would not materially affect the price. An objection might be raised that a large crop would hardly average as much as a smaller one. This would be applicable where the forcing, the working and manure are superior on the smaller; but not where the reverse would obtain. The manuring consisted of a small shovelful of leaf mold mixed with cow manure and a trifling addition of poudrette. Of this leaf mold I have a thick deposit, eight years old, on 100 acres. The working consisted in the use once of Allen's horse hoe, one plowing and three hoeings.

The sixth picking on 16th June, amounting to eighteen boxes, included fruit from additional plants, which had not enjoyed the advantages of those boxes, and brought $124; the seventh and eighth brought eighty-four and $132 respectively, and so on until the decline in prices rendered further shipments unavoidable, and leaving the bulk of the fruit of the inferior plantings still in the field, thus rendering the income less, and my figures smaller than they should have been. You will have perceived, without my drawing your attention to the fact, that the prices obtained for the produce, owing to my having been first in the market, and I think made five shipments before any of my competitors came in, is the only remarkable circumstance in my whole exhibit. Previous to the war, and before fire and the sword had swept over my plains, I placed ripe tomatoes in the Savannah market May 17th. It is plain that on superior land, more advantageous situation, and the same means, I ought to be able to send green fruit at least as early, which would make a considerable difference in the bulk to be shipped and the money to be received.

I have made this statement for the purpose of attracting the attention of many who I know are wishing to engage in this very line of business. I have plenty of land, and the situation is as good for marketing purposes as any in Georgia. If any member of the Club or its correspondents would like to engage with me, and have some capital to apply to such an enterprise, I should be most happy to secure an industrious ally. Letters should be addressed to Dr. A. Oemler, Savannah, Ga.

Mr. J. B. Lyman.—I have received more than twenty letters within a year from readers of the Club reports, asking for information about an enterprise just such as Dr. Oemler describes. I believe there is a very handsome income from southern gardening for one who knows the New York market and can send the right thing at the right time. I hope inquirers for sea-board lands will read this statement, and open their plans to Dr. Oemler.

Dr. Isaac P. Trimble.—This appears to be a move in the right direction. The effect of it will be to give the northern cities tomatoes and other good things all summer, and such supply will do more than all the drugs I know to promote health and longevity. This country has climates enough to give us every fruit and vegetable that grows. All we require is gardeners enough and steamships enough.

Pecan Nuts.

Mr. C. F. Dewer, of Houston, Texas.—Let me tell you what can be done in the county of Harris, within twenty miles of this important commercial point, insuring to the patient and enterprising not only large but annual returns, after fifteen years, by merely enclosing the prairie land with wire fencing, to keep the cattle off, and planting it in pecan trees. The soil, climate and location are all adapted to the successful growth of this tree; and the young trees, of size to set out can be had from clumps and branches, or creeks in the prairie, and the neighboring San Jacinto and Brazos rivers wood lands. But even from the seed the trees will bear pecans in fifteen years as an average, some trees will produce earlier. The land for this purpose can now be had at eight dollars per acre. In addition, one could secure an immediate annual income from cutting the fine prairie grasses for hay, commanding ready markets at Houston and Galveston cities by means of railroad transportation of ready access. Every one admires the richness and fine flavor of the pecan nut, and there has never been a time in Texas they have not been cash at one dollar and fifty cents to three dollars per bushel.

Bloody Milk.

A cure was solicited by Mr. D. E. Foster, of Cape May, N. J.

Mr. Frank D. Curtis advised poke-root; and, in reply to a question touching the cause of the disorder, he explained that it is generally believed to be the result of inflammation of the udder, consequent upon internal bruises. These are frequently chargeable to the cruelty or carelessness of boys, who hurry the cows over the bars or worry them with dogs, or, worse yet, harass them with stones. The good husbandman will avoid the possibility of these things, and thus be seldom afflicted in his herd in the way complained of. However, it sometimes happens that cows bruise themselves, particularly if they chance to forage in new ground where stumps and brush abound.

Gardens of New Jersey.

The President spoke briefly of a little trip of his into the borders of the country of Camden and Amboy. Leaving New York city one afternoon last week, he crossed the ferry to Jersey City, and went thence by cars to Newark, where he paused awhile at the hospitable home of Mr. D. B. Bruen, a glimpse of whose well-kept gardens were worth a longer ride. From this point he moved forward to Dr. Trimble's charming habitation, located on higher ground in the same town. Here he found evidence of unusual taste and culture, and looked also upon the results of much manual labor, for most of which latter Dr. T. himself claimed credit. Still further on, and he reached the premises of Mr. Pierson, who, with only six or eight acres, does each year something really remarkable in way of crops and fruit.

Dr. I. P. Trimble.—I am pleased to hear our worthy chairman speak thus of Mr. Pierson. He deserves high praise. Among his other achievements he has worked out the problem that French fruits are, for the most part, unsuited to our soil and climate. He has found this particularly true of grapes. Starting out with the French varieties, he proved them poor, and has now discarded them. His pears, too, have been regrafted, and he is now mostly devoted to the Bartlett.

Mr. A. S. Fuller.—True as the insinuation against French grapes may be, it is at least equally true that our best varieties of pears are of French origin.

Adjourned.

September 6, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Chinese as Farm Laborers.

Mr. George S. Hawley, New Haven, Vermont, would know whether they go in squads or singly, and if they make good hands.

Mr. J. B. Lyman.—This opens a question of the utmost importance; one that will shake our politics almost as vigorously as we have been shaken by the negro. I am informed by our friend Mr. Reade that he will, next session, present an essay on this point. To Mr. Hawley's question I will say, that the Chinaman does not labor so well singly. He is by nature a sad man, and when he is unhappy he kills himself. In gangs he is much more cheerful and works better. They like to work by the job. In the great grain States of the west, as Illinois, Iowa, Wisconsin, and especially Minnesota, they will soon be traveling in great gangs, and binding and stacking grain at one dollar and one dollar and twenty-five cents an acre. He is not very good with horses, and not as strong and plucky as an American or a first-class Irish or German hand. Garden work and light but steady employment, as stripping tobacco, suits them. On a large place they would work in with other and stouter hands, and be excellent hands; but it is better to keep them mostly to themselves, and let them do work that suits them. On a great grain farm, on tobacco or cotton or sugar places, they will serve an admirable purpose. They are content with a little; but of course will get as much pay as they can, and will leave for better wages as soon as more is offered. They sleep on a straw bunk, and eat rice and stewed chicken. They know nothing of strikes or mutiny. They will take much abuse, but if made wretched they commit suicide. I do not recommend to Mr. Hawley and others to get one; but let him and five or six others club together, and send to San Francisco for Yang-Sing and nine others. Yang-Sing must speak some English and act for the others, collect their wages, see that they have a doctor if sick, provide fire-crackers and joss-sticks, and agree to send their bones back to China if they die. But meanwhile Mr. H. should become a home missionary, and teach them New Testament and the doctrine of the resurrection of the just, through faith, in a risen Saviour.

Room for Farm Foremen.

Several letters were read from correspondents who have been accustomed to the occupations of the agriculturist, and who would like to improve their condition by changing their spots. Mr. Lyman expressed the opinion that there are chances enough for intelligent, thrifty and sagacious men to manage estates. He remembered that Mr. Fuller remarked months ago that there were probably fifty such places in the vicinity of New York. Mr. Horace Greeley thought it a case of very great difficulty to find men competent to fill the places Most such are striking for land of their own. Mr. H. L. Reade sug gested that a committee be appointed to take the matter into consideration, a sort of labor bureau. Agreed, and Messrs. Lyman, Reade and Quinn were chosen.

THE PEST OF THE CABBAGE PATCH.

Mr. A. S. Fuller showed specimens of a worm which is destroying cabbage in various localities, and said: It is not a native of this country, but was supposed to have been imported into Canada in 1856 or 1857; at least it made its appearance near Quebec about that time, and from there it has spread very rapidly in various directions. This worm is the larva of what is known in Europe as the small cabbage white butterfly (*Pieris rapæ*). The body is black, the front wings white, slightly tipped with black, and a small spot of the same color in the center of each. The hind wings are usually a pale yellowish white, sometimes with a shade of green. The female usually has two spots of black in the center of the fore wings, with a rusty gray or yellowish tinge covering the whole. By visiting any infested cabbage patches, these butterflies may be seen hovering about the plants. They deposit their eggs singly on the under side of the leaves. Sometimes two or more eggs will be found near together, but not in an agglutinated mass, as often deposited by other kinds of insects. The worms, when full-grown, are about an inch and a half long, pale green, with a very small yellow stripe down the back, and minute yellow dots along the sides. These worms not only devour the large leaves, but bore into the center of the largest cabbage head. Salt, slacked lime or guano will check this pest when it first attacks young plants; but it soon burrows into large heads, and is then beyond the reach of outward applications. This cabbage-worm subject is one of great importance, and we know there are, at this moment, hundreds of persons who stand appalled at the destruction which is being wrought.

Mr. D. B. Bruen.—A friend of mine writes that there will be no cabbage crop in Canada the present year, in consequence of the depredations of this pest.

Mr. O'Donnell.—Out on Long Island I have not found salt as effectual as Mr. Fuller seems to think it. I have tried ashes, and they don't answer. Kerosene kills the cabbage, but don't kill the worm.

Dr. Isaac P. Trimble.—Try poultry, but beware of Paris green.

The Chairman.—I visited P. T. Quinn's place last week, and found that his patch, which contains some 80,000 heads, was also attacked. Perhaps he will tell us how he treats the ravishers.

Mr. P. T. Quinn.—I have tried no less than fifteen different powders or decoctions, and find the best result from the application of a mixture composed of twenty parts sulphate of lime, one part carbolic powder, and three or four parts of quicklime. This I sprinkle in small quantities upon the leaves and parts affected, making the application in early morning, before the dew is off, or after a shower. Frequent repetition is sometimes necessary.

Willow Fencing in Nebraska.

Mr. William Young, Palmyra, Stoe county, Nebraska.—I have willow from seven to twenty feet high, seven years old, and not a rod of it a good fence. Last year I was troubled by a worm which ate the leaves, and this year they are more numerous, three-fourths of the leaves being already gone. The worm is two inches long, five-sixteenths thick, with a light yellow, very firm and tough skin, six hooked feet, about eighteen not hooked, with about as many fine black spots, one above each leg. They commence to fall and spin their cocoon the middle of July. It's rather a formidable job to kill them, as I have one and a half miles of hedge, and counting both sides, three miles. My Osage is nearly four years in the hedge. It has winter-killed some every year; last winter three-fourths killed to the ground. I account for it by clean culture and a very wet summer, making a rapid growth and a late one. Some of the neighbors neglected theirs, and they came through as usual. It requires considerable patience to make a good fence. Its chief enemy is the pocket gopher. In spite of watchfulness they will sometimes make a gap. I have best success in destroying them with a steel trap.

Summer Management of Swine.

Mr. W. H. Wilmot, Lawn Ridge, Illinois.—Living within sight of the smoke of my chimney are more than fifty farmers, each of whom will sell from $1,000 to $5,000 worth of pork next fall. As near as I can learn by talking with many of them, they all think that now is the accepted time for erecting steamers and getting mills. They keep their hogs on clover pastures, and all who have mills (and many are just getting them, even if it is not so proper a month as November) cook small portions of corn meal for the hogs. In this section, no milk is fed to the hogs, for the reason that there is hardly enough for the people. Farmers have found that hogs cannot live and thrive on grass alone, but by making swill with cooked meal they keep the hogs growing, thereby "getting large-frame hogs before the corn hardens." These farmers generally plant quite large quantities of early sweet-corn, which they cut up when in good roasting ear, and feed, stalks and all. The success of these swine herds, for a few years past, has been due to the course I have given. Nearly all began poor, and now are rich.

AGRICULTURAL POSSIBILITIES OF THE PLAINS.

This was the subject of the following address by Mr. J. B. Lyman:

During our tour across the continent, I took special interest in the vast grassy slope that extends from the snow-banks of the great water shed eastward to the long rivers of the Central valley. It has been generally supposed that active productive industry would be arrested about 200 miles west of the great streams, by the poverty of the soil and the lack of rain. On the early school maps this region was labeled, "the Great American desert, roamed over by countless herds of buffalo and numerous hostile tribes of savages." As we traveled west from Omaha the country was a prairie, differing in no respect from the savannahs of Illinois and Iowa, west of the mouth of the North Platte, a point 300 miles east of the mountain crest, the prairie features and its dark, unctuous soil gradually disappear; the grass is shorter and less juicy, the surface a little broken, some calcareous and felspathic rocks cropping out. But I was satisfied that the nutritive power of the grass increases as we leave the black lands; the gramma or bunch grass *looks* white, sere and innutritious, but it is found to nourish cattle as well when quite dry as when it first springs from the sod. Thus these plains can support cattle as well in winter as in summer, excepting a few days of storm and excessive cold. I was surprised to find the soil of this extensive region so good. In places it appears gravelly, but this is because of high winds blowing over a dry surface; the dust is removed and the little gravel stones left. This gives a deceptive appearance to the surface, but a little digging convinced me that the soil proper is, in most places, a foot deep; and beneath the soil, or that part of the earth that has been directly acted upon by the elements and mixed with organic matter, we found a subsoil of firm, rich, and dark clay. Much of it is adapted to making the best of adobe brick, so that the walls of a house can be erected from the excavation for the cellar. The composition of the soil of the plains can be known from the nature of the rocks from which it has been ground. On the crest of the Black Hills at Laramie Pass, the surface is covered with pebble stones and fragments somewhat larger than pebbles, the result of the breaking down of the range at that point. These pebble stones continue all the way down the slope of the plains for 100 or 200 miles, and they are the same over millions of square miles. They indicate the breaking down of the eastern ridges of those mountains, and the soil thus composed is, of course, made up from the mountain rock rendered fine and mixed with a little organic matter. A very competent geologist, Professor Vincent, of London, and a member of the Royal Geographical Society of England, with whom I traveled from Chicago, and who has made the Rocky mountains a special study, says they are remarkable for being made up to a great extent of binary granite. He calls it granitel, and says it consists mainly of felspar and quartz. This felspar is well known to be rich in potash, and the potash is the more easily released because of the friable character of the rock. Air and moisture break down a ridge or a mountain made up of this rock, and the soil thus formed is as rich in this grand element of potash as any soil in any part of the world. Of course, all plants consuming potash, as grasses, the white grains, fruit trees, cabbage, tubers, and roots, cannot fail to prosper in such a soil. The only problem, in the case of such as require tillage, is to moisten the earth enough to make the potash and silica soluble. But without reference to irrigation, the moisture of the melting snows and spring rains on the plains is enough to foster a growth of the most nutritious grasses, and there are sound geological reasons for believing that the element of potassa is practically inexhaustible in the soil of the plain. I found at one digging a bed of fine mold or tilth, four feet deep, lying over a thick stratum of felspathic gravel stones, and the pebbles quite freely mixed with the tilth. A thousand years of cropping would not draw all the potash from such a soil. The extent of the region thus formed is very great. In a general measurement it is 1,000 miles long by 300 miles wide, or an area of 300,000 square miles, six times as large as the State of New York. An experienced herdsman on the plains told me that 100 cattle could find subsistence on 640 acres. The whole number of horned animals that could be supported on the surface is 30,000,000. One-third of these (10,000,000) could be converted into food annually. Ten million of cattle would generously supply thirty cities as large as New York with their beef. It is to this grazing and beef-producing power of the great plains that I especially call the attention of the Club. I know of no business more flatttering to the man of youth and enterprise who does not flinch from some exposure and solitude. There is occupation for a man on every square mile of the plains in tending stock. Three hundred thousand persons can, during the next twenty years, find occupation that will give them a support, and if they have vigor, thrift and patience, the business will give competence. I have no fear that the beef business will be overdone. Our meats are costing much more in proportion than our breadstuff. I must give one dollar for a ten pound cut in the cheapest meat market on the continent. That dollar at Milwaukee or Chicago, will buy me a bushel of good wheat. In New York the contrast is greater. The money that buys a ten pound roasting piece will give me 100 pounds of nutritious, though not the whitest, flour. I know of nothing that will adjust this discrepancy but the development of the flesh producing power of this great region, already intersected by two railroads, and soon to be cut by many others. Nothing is likely to arrest the flow of life and labor and capital westward. Those vast grassy savannahs are as valuable and can be made as productive of food as the moister and darker lands of the prairie States. We cannot contemplate this subject in all its bearings without an admiring reverence for the consummate plan of the Creator of this continent. Beyond the great central valley, so perfectly adapted to tillage, he has ground down the rocks of towering peaks and spread them, rich as they are in all the elements of nutritious vegetation, over a belt three hundred miles in width. By climatic laws he has deprived most of this region of the moisture necessary for tillage, but given it enough to grow an abundance of nutritious flesh-producing grasses. Having thus with infallible forecast fitted the central region of our continent to produce food for millions upon millions of industrious people, the invitation thus extended is sounding in the ears of every poor man. Every sufferer in crowded cities, every weary spinner and weaver, all workers in wood and all workers in iron who would wash away the grime of the shop, come riot in plenteousness, and with your surplus make bread and flesh less costly in 10,000 other homes.

Mr. H. L. Reade.—Mr. Lyman has not told us, in his admirable address, how the herds are to be supplied with water.

Mr. J. B. Lyman.—While, according to my calculation, 100 animals can be kept upon every section of 640 acres, I have no idea that the sections will be fenced and the animals thus confined. The various tributaries of the Missouri and the Arkansas will supply the necessary drink to millions. When, after a time, it becomes inexpedient to have the range so extended, Artesian wells and irrigating ditches taken from the Platte, the Huerfeno and the Cache will supply immense districts. An old hunter told me that in the belt between the Union Pacific and the Kansas Pacific was formerly the favorite range for millions of buffalo. If they found water, I see no reason why millions of tame cattle cannot do as well on the same surface.

Dr. J. V. C. Smith.—It is perhaps fitting for me to show at this point some cones from the great trees of Calaveras county, and some other curiosities I have brought from the Pacific slope. The audience are at liberty to pass them around and look them over. Some other time, soon as I can find leisure for the work, I hope to present a paper which shall contain brief accounts of what I saw in the Yosemite and in some other wonderful and horrible places I was glad to get into and equally glad to get out of.

American Peach Stoner.

M. Greenwood & Co. sent to the Club some of their peach stoners, which were referred to a committee to report on.

Latchers' Curry Comb.

Mr. J. W. Latchers, Edinburgh, Saratoga county, N. Y., sent a package of his improved solid hard wood curry combs, which were distributed, with a request that the parties receiving them should report at a future meeting.

Adjourned.

September 13, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Chinese Farm Laborers.

On this subject Mr. H. L. Reade presented the following paper: The first question to be considered is, do we need the Chinese? For years the workmen on our farms have been paid more than they could earn. Before the war the wages and board of the best hands reached thirty dollars a month. During the war, and since its close, forty dollars has been a fair average eight months out of the twelve. Either of these sums have been above what the condition of the market for farm products could bear, with a possible exception of a part of sixty-three, sixty-four and sixty-five, when all values were fearfully inflated. All this has been, and is, inevitable in a newly settled country. It has been partially compensated, as it always is, by the rise in real estate, which, added to the little left to the farmer after paying his help, has given him some, though generally a meager return for his labor. But land in the east and in the great interior has reached its maximum value. In three-quarters of these States the censes of 1870 will show little, if any, acreable valuation above that of 1860. To hire help, therefore, in ordinary circumstances, at the rates hitherto paid, is not among the possibilities, if those who cultivate land expect to live by their business and add somewhat as they should to their estates. Our present farm laborers will not, in fact cannot, work for much less than they now receive. Their habits, as individuals and families, are expensive, and before submitting to any considerable reduction, they will go, as they should, to sections where land can be had for the asking, and where they can hope for fortune through the same channel in which it has come to all parts of the country, each in its turn. Their places must, therefore, in the nature of things, be supplied by a nation or race, whose habits, formed in an old country, do not partake of the extravagances that pertain to a new, and whose hours of work have never been abridged by those abnormally anxious to get some special work done, and therefore willing to pay the largest possible price for the least possible labor; and who, therefore, are willing to accept such compensation as the employer can afford to pay, and such regulations as will be for the interest of both.

That man is the "heathen Chinee."

He comes at a time when he is specially wanted, and into a place open and waiting for him. Can he fill it? Partially at first, completely afterward. What are his characteristics? Physically, his average strength is about seven-eights of the Saxon or Celt. He will wear longer than either. Pat can pitch on a load of hay quicker, if he tries. Taking ten loads together, John will come out ahead, both working exactly as the notion takes them. The Asiatic never frets, therefore is never tired, and is rarely sick. Mentally, he is the equal, in his way, if not the superior, of most of the working classes. He can already read and write his own language. He has anxieties to learn that will make him a scholar, not a teacher; a subject, not a king, for some years. He will, therefore, do what he is bid without gainsaying or delay. He has persistent though plodding industry; is more willing than most others to live up to his contracts; and, expecting to work, he always does it without grumbling words or questioning, dissatisfied thought. Can he do the work on our farms? He can. In his own country, generally speaking, he is a farmer first, afterward something else, if he is forced to be. In this country he adapts himself to his situation; and if he can work in the mines, repair railroad track, manipulate machinery, spin, weave, and at length finish the matchless fabric, make shoes, make nails, make houses, each of which I have seen him doing in a most satisfactory and effective manner, why can he not do the work on a farm, that requires in the workman less skill, less judgment, than many an employment for which he has shown wonderful adaptation, and after the briefest apprenticeship, wonderful proficiency?

One or two incidental considerations. On the smaller farms in the east, and to some extent everywhere, circumstances make it imperative to board the help on the farm and admit them to a common table. In this way the sanctity of the family is invaded, and much evil is inevitably wrought. No mother but wishes her children to be wholly hers while in her own home, and not have either manners or morals subject to the influence of a course and perhaps wicked workman. Besides, any additional membership from outside, involves thought and care and labor not needful with the family alone; and thus what is most imperatively demanded, woman's work would be lessened by having the outside farm labor done by men who insist upon personal isolation as much as possible, and always prefer to get their own meals, and eat them in their own way. So far as my range of vision extends to-day, I see nothing but good to the farmer, good to his hitherto workmen, and good to our Mongolian brothers in the necessities that are providentially upon us, and the changes they so certainly portend. Let the men that have tilled our fields till their own. Millions of acres have been waiting ages for them. And let the men, tired of toil that brings no fitting recompense, come where the profits of the field can be equally divided between capital and labor, giving to the representatives of both mental satisfaction and mutual thrift.

How to get the Chinaman, what it will cost, and the best mode to instruct him in the mysteries of our work, will form the subject of a future paper.

Dr. J. V. C. Smith.—The paper just read is a broad, clear, comprehensive statement of the case. The Chinese are coming. We cannot prevent them if we would. We would not if we could on this side of the Sierras, though great efforts are being made to do so on the other. He will fill a place here that will hinder no other man, but, as I firmly believe, will help all.

Dr. I. P. Trimble.—If his labor will deliver us from the tyrannies to which persons who employ some classes of help are subjected, let him come.

Mr. William Lawton.—In latter years the subject of labor has been growing in importance. The price of farm labor has come to be so high, in consequence of the great demand of the various manufacturing establishments, that farming has come to be scarcely within the province of any, except those with considerable fortunes. So when I hear suggestions like these, coming from a source that carry with them weight, and that are calculated to help all and harm none, I am in favor of putting them before the people and inviting their adoption.

Mr. J. W. Gregory.—They come to this country without women, and I do not believe it to be for our interest to encourage emigration when only one sex is represented.

Dr. J. V. C. Smith.—They bring their mothers and their sisters, and their wives as fast as they get the money to do so. All this will correct itself. How did the Irish do years ago? They came themselves, earned money, and then sent home for their sweethearts.

Dr. H. Sheppard.—It is questionable if the accumulation of wealth ought to be the highest ambition of a nation. If these Chinese come here they will be heathens, and we shall have an antagonism of religion that will be extremely disagreeable. The Chinese have no progress in their composition. They have stood still for 4,000 years. What do we want of such a race?

Mr. A. L. Fuller.—Let the Chinese come. I will risk their religion. They may do some of us good, and as to workers, they will do as we tell them, and that is what we want.

WHITE AND YELLOW DEPOSITS UNDER MUCK.

Mr. Warren Martin, East Pembroke, N. H.—I send a sample of two substances which we dug from under a bed of muck. We find after taking off about a foot of muck a layer of from eight inches to a foot of the white substance, and beneath that a layer of from twelve to eighteen inches of the yellow. The place where we find it is a low springy run. I would like the opinion of Prof. Whitney and others of the Club, about what the substances are, and of what value.

Prof. J. A. Whitney.—The white earth is chalk, and worth three or four cents a bushel as it is, and fifteen or twenty cents a bushel when burned. The question of burning depends on the price of wood and the cost of work. The yellow is a kind of ochre, and might, if worked fine and mixed with a stronger yellow and with oil, make a good paint for barns and fences.

GAS TAR FOR YOUNG TREES.

Mr. Eli Parker, Gaines, N. Y., asked if gas tar will do harm to young trees when applied as a mere preventive.

Mr. A. S. Fuller.—I shouldn't like to run the risk. Tarred paper is equally effectual, and may be used with less fear of fatal results.

Mr. D. B. Bruen.—I advise the application of a salve made of equal parts of bees-wax, shoemakers' wax, and tallow.

Mr. H. L. Reade.—I prevent the ravages of mice in my orchards by removing all vegetable growth about the trunks, and keeping the snow well stamped down.

Mr. J. B. Lyman.—Gas lime applied at the root of young peach trees has a happy effect in keeping away the borer. He can probably obtain it at Rochester or any city where gas is used. To prevent the gnawing of mice the best thing he can do is to throw up a bank of earth or manure a foot or two high just before frost, and remove it as soon as the buds swell. Besides keeping away mice it protects the lower end of the stem from injury by hard freezing.

Farming in the Brandywine Hills.

Dr. Isaac P. Trimble.—During the recent vacation I had the pleasure of visiting a considerable portion of Delaware and Chester counties, in Pennsylvania. I traveled among the Brandywine hills, so famous for first-class agriculture.

I was on a farm of 850 acres, owned by two brothers, and worked by the four sons of one of them. Could full particulars of the management of this superb farm be spread before the agricultural world by this Club or the editors of our agricultural papers, it would afford a model of successful farming which, if adopted, would soon greatly increase the amount of human food. From the top of the house of one of these brothers, miles and miles of these celebrated hills can be seen in every direction, forming a panorama of agriculture probably unsurpassed in our whole country. You can almost see the "cattle on a thousand hills." A small valley of forty acres was pointed out to me, on which forty cows have found an abundance of pasturage every day since early spring. Cornfields upon the hills were shown me that it was said would yield 100 shelled bushels to the acre. Verily, "the valleys there teem with abundance, and culture has conquered the mountains." I have lately seen an account published of this Club, in which it was said, "we are a perpetual agricultural congress;" and, judging from the number of letters received, asking for information on all kinds of subjects connected with agriculture, we are considered of some authority. Here is responsibility. Now, I propose that a committee be oppointed by our chairman to visit the farms and farmers of not only this Brandywine region, but also several sections of southern

New Jersey, and report the details of the systems by which land has been made to produce such bountiful crops.

The committee asked for was appointed, and consists of Messrs. Horace Greeley, D. D. T. Moore, A. S. Fuller, A. B. Crandell, H. L. Reade, H. W. Raymond, J. V. C. Smith and N. C. Ely.

West's American Tire-setting Machine.

Mr. H. L. Reade described this contrivance for tightening the tires on old wheels, without removing the tire or injuring the wheel. It is only necessary to remove the wheel from the axle, put it in the machine, put from thirty to sixty tons pressure on the iron, which instantly upsets the tire, as the blacksmiths say, at a cost very much below what is now paid. It is alleged that the machine will save to the farmer a large sum every year.

Food for the Mind.

Mrs. Defiance Smith, Perryville, Ohio, asks what is the proper food for students and others whose brains must work harder than their hands.

Mr. T. B. Briggs.—The fact is well established that phosphorus is an important element in the brain and nerves, and that high mental activity and nervous excitement are exhaustive of this material. The author of the "Philosophy of Housekeeping," states that a number of years ago Cowerbe, a French savan, claimed to have come upon a discovery which made the presence or absence of this element a measure of mental soundness and power. He said he found twice as much phosphorus in the brains of sensible people as in the brains of fools, while the brains of insane people had more than a proper proportion of this element. Later and more careful analysis failed to corroborate these views, but it has come to be generally acknowledged that nervous and mental activity demands food which abounds in this salt, and that which contains it in such a form as can readily be assimilated. Our cheerful correspondent is right in supposing that cabbage is not suitable food for the brain-worker, and it is equally true that onions, pork, beans, and kindred substances, are also objectionable. We have, too, Prof. Agassiz's authority for the statement that phosphorus is demanded. Therefore, fish is to be advised. The flesh of fowl or game is excellent, if it be tender, and eggs, cooked comparatively soft, are to be included in the list. These, however, are all concentrated substances, and should be eaten with acids, baked sour apples and currants or cranberry sauce. Beefsteak is also advised, especially for those whose work is half sedentary and half upon the street; but it is stimulating in its nature, and therefore not quite compatible with the even tenor of spirit which should characterize the student.

CALCULATIONS FOR CISTERNS.

Mr. J. S. Davis, Columbus, Indiana.—I am building a cistern on the plan given by Mr. Geddes. How large a pipe do I want to conduct the water to the bottom of the filter? Of what material should it be made? How many squares of roof will it take to catch rain enough to fill it during the winter? The dimensions of the cistern are fourteen feet long, ten feet deep, eight feet wide.

Mr. A. S. Fuller.—A little calculation would have given him the knowledge he desires without sending so far for it. He has a little more than 1,100 solid feet of capacity. If his shed or roof is 100 feet long and ten feet wide, a rain-fall of one foot would nearly fill his cistern. There is generally a fall of cold rain, suitable for storing in a cistern, of at least a foot, in Indiana, and often much more. Let him multiply the length of his plate by the length of the tie that connects the plates. That will give him the number of square feet that collect for his cistern. For instance, if his plate is forty-five feet, and his tie twenty, he has 900 square feet collecting for him. A good heavy rain of four inches would give him 300 cubic feet, or his cistern over a quarter full. If he has twice as much roof, of course a rain of four inches would more than half fill his cistern. Three inch tin pipe is the cheapest, probably, for him.

AN INEXPENSIVE ICE-HOUSE.

S. Mead, of Milford, Mass., would know how large and in what way to build an ice-house so as to contain four or five tons of ice, or sufficient to supply a family, and what would be the probable expense.

Mr. P. T. Quinn.—Let him part off say ten square feet of his woodshed or barn, and dig a drain from the bottom, which may be three or four feet below the general level of the ground. Provide a quantity of marsh hay or straw. When the ice can be cut in large blocks, pile it in a cube eight by eight, and then stamp the straw very solid all around and throw plenty on top.

SYLVESTER'S NEW SEEDLING PEACH.

Dr. E. Ware Sylvester, of Lyons, N. Y., forwarded, by express, some specimens of a new seedling peach which he calls the Richmond, and for which he claims: 1st. That it is more hardy than the early Crawford. 2d. That it is as large as the early Crawford. 3d. That it is as firm for marketing as the early Crawford. 4th. That it is as handsome as the early Crawford. 5th. That it is as sweet as any first-rate white peach, lacking the acidity of the Crawford, however ripe. I grew 500 seedlings from selected seed, and the Richmond and Atlanta, a white peach not yet quite ripe, were the only ones I deemed better than varieties which we already had.

Mr. J. B. Lyman.—I have a great many Crawfords this year, and they are fine looking and sell well. No peaches brought to the Trenton market sell any better than my large Crawfords and Oldemixens; but the flavor of this new peach of Dr. Sylvester's is better than any Crawford I ever ate, and the size and color are fine.

Adjourned.

September 20, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

CISTERNS.

Mr. S. B. Starbird, Plattsmouth, Nebraska, asks the cheapest and best way of saving rain-water for family use.

Mr. William Lawton.—I have on my place at New Rochelle a cistern, made of cemented brick, which has been in excellent order for several years, and with which I am much pleased.

The Chairman.—I have had the pleasure of paying for no less than three different cisterns during my lifetime so far; the first was built after the manner Mr. Lawton describes; the second was built of common rough stone, cemented on the inside. This has been standing for no less than twelve years, and is still a perfect success. It cost only half as much as the brick one. The third was constructed at still less cost, barely quarter that of the first. A hole was dug, with sloping sides, in a stiff, hard soil, and the cement was applied direct to the surface. This was done in 1858. The cistern has been in constant use ever since, and seems to be as good to-day as ever.

Mr. Frank D. Curtis.—A good cistern can be made in a solid clay soil, if not in an exposed situation, by cementing against the sides of the ground. Where the ground freezes I would not recommend such a practice, but to lay a wall of cobble-stones in a mortar of cement, and face the wall with a thick coating of clear mortar. Great care must be exercised to get good cement, and mix it with coarse sand. Fine sand will not do at all. One part cement and three parts sand is the usual proportion, to be used as soon as mixed. Every part of the wall must be laid below the reach of the frost. This can be done, and an iron or wooden pipe or throat lead to the surface, through which the pump can pass. A cheap and excellent cistern can be constructed of wood in the form of a large cask or tank, made of pine or cedar plank. When sunk into the ground, and being kept constantly wet, they will last for years. A better way is to place the cask or tank in one corner of the cellar, with a faucet in the bottom, from which the water is easily drawn when it is desirable to clean it out, and when water is required in the cellar. A cellar with an open cistern in it will rarely freeze.

Improvement of the Tomato.

Mr. M. D. Wilson, Rochester, N. Y.—I have been much interested in the attempts that have been made and the success attained in the improvement of the tomato. Great quantities are now used, and considerable land devoted to the culture. Among market-gardeners there is considerable strife who shall have the earliest, as a few bushels in the early part of the season decide, in a good measure, the profits of the crop. Among the earliest ripening varieties that have been introduced, Hubbard's Curled Leaf, sent out last season by Mr. Vick, proves to be one of the most valuable. It is quite dwarf in habit, and may be planted three feet by two feet. The fruit is solid, contains but few seeds, and ripens well up about the stem. Some varieties of tomatoes will ripen a few specimens very early, while the general crop holds off for some time. This sort brings forward its entire crop with great rapidity. My experience the present season has been with 175 plants on a sandy soil, but with no protection, being fully exposed to the wind in every direction. I planted the seeds on the 24th day of April, in a mild hot-bed. When two or three inches in height the plants were put into a cold frame, and allowed to remain until the 4th of June, when they were transplanted into the open ground, having attained about eight inches in height. On the 28th of July I picked a half bushel of fully ripened fruit, eighty-nine days from the time of sowing the seed. My plants have never received any check since they came up, and when transplanted into the open ground were carefully removed, with balls of earth attached. I consider it absolutely necessary to raise early fruit that the plants receive no check. A cold rain, succeeded by a few cold days immediately after transplanting, will often defeat the chance of an early crop, and delay the ripening many days. Many transplant immediately after a rain, while the ground and air is yet cold. It is better to wait a day or two, as the plants will suffer less from wilting than from cold. August 6th, I picked the first ripe Trophy tomatoes, and several plants had one or two nearly ripened specimens each. Just ninety days served to perfect the plant and fruit. The vines are heavily loaded, healthy and vigorous. I feel confident that this tomato will prove one of the most valuable varieties we have had. I hope to hear all about it from those who have tried it the present season. I trust I may be pardoned a little enthusiasm; next to a dish of blushing, melting peaches, present me one of well-ripened tomatoes.

Mr. J. B. Lyman.—While we have these high and probably deserved praises of the varieties named, and especially that sent out by Colonel Waring, I wish to refer to the tomato introduced last spring by Mr. Lowe. He called it Lester's Perfected. I took his seeds and gave them no special care. The tomato I find in my garden this fall is large and smooth, of a pale red or pink tint, and remarkably solid. The cavities, so usual in this fruit, seemed filled out by the flesh, and I find the flavor delicate. The habit is thrifty, and it bears twice as much by weight as the common red or the York. I find that early ripening is not a quality that gives great value to a tomato. My late variety sell about as well as the early; and I have gained little or nothing by buying hot-house plants. Those started in the window in a box or on a turf, fruit about as soon. As a fertilizer, I want nothing on light, sandy soil but a pinch of bone-dust. When the plants need pushing in the spring, we water with a liquid fertilizer, made by pouring hot water on a handful of bone-dust.

Mr. H. L. Reade.—I had seeds enough of Lester's Perfected to raise five plants. The vines ran from seven to ten feet. We have picked all we wanted for use in the family, and have bushels left. At home, in eastern Connecticut, we regard it as the best variety we have ever cultivated.

Mr. T. B. Briggs.—To show that Lester's does well in different localities, I may mention, that, in course of a recent conversation with George M. Joy, of Tom's River, N. J., I learned that he cultivates several sorts, and regards this one as superior.

Mr. Frank D. Curtis.—I have some notions about tomatoes, in a general way, though my experience with varieties has not been extensive. Tomatoes of any kind can be made earlier by clipping off the vines as soon as one or two settings of fruit are made. The Trophy is good; so is the Tilden. These are the earliest, and earliness is a great virtue; in fact, the most essential. I think it is a good idea to start the plants in a hot-bed, and transplant them two or three times in the bed before setting them out in the open ground. In this way new rootlets are developed, and the plant gets a more stocky growth. Frequent hoeing, if only to stir the ground, will hasten the growth. Plaster is good. With most farmers in our northern counties, tomatoes are difficult to grow, as the frosts catch them before they get ripe.

THE GRAMA OR BUNCH-GRASS OF THE PLAINS.

Mr. N. C. Meeker, Greeley, Col.—I send you herewith two samples of the celebrated grama grass, growing parallel with the Rocky mountains, over a region 200 miles wide, east and west, and perhaps 1,000 miles wide, north and south. No. 1 is a good sample of it, as found growing everywhere on these plains. No. 2 is the same, growing on the brink of my irrigating ditch, but not having had water to it. I hope it will retain its fresh green color, to show what the sight of water will do. The other, No. 1, cannot well be browner nor drier, and yet it is undoubtedly the most nutritious of all grasses, and it is about as good in winter as in summer. This grass grows everywhere, but it does not cover the ground. The cactus or prickly pear occupies considerable space. While this grass has remarkable fattening qualities, being perhaps nearly equal to oats or corn, the fiber is too stringy and tough to make tender beef; and a finishing process of roots or grain, fed in stables, is required, although no one here has yet thought of such a thing. I may mistake, but this is my judgment in the case. The soil on which this grass grows is exceedingly rich, made, as it is, of pulverized mountains, and when it gets water from our ditches all kinds of vegetation grows at a remarkable rate; grows better than is the case in a rich old garden, while the yield is enormous. It is a question I have been unable to decide, whether manure is of any benefit. So far, I cannot see that the least effect is produced, but I shall continue to make experiments. This is an exceedingly dry country. Manure becomes as dry as dust in a traveled road; nor, so far as I have seen, does it dissolve in water, for it seems to remain the same dry material when water is withdrawn. I think, perhaps that if it should be plowed in during the fall and winter, and water plentifully applied, some good may result; but I must confess that at present the prospect is much like putting one breakfast on top of another. All the manure we seem to want at present is water.

CAPE MAY COUNTY, N. J.

Mr. J. B. Lyman, who recently visited the southern extremity of New Jersey, spoke substantially as follows: You may remember, Mr. Chairman, that we have had several letters referring to the bland climate and the excellent soil of the southern tip of New Jersey. I had the pleasure last week of visiting that part, and noting its agricultural attractions. It is a tongue of land nearly 100 miles south of New York, and having great bodies of comparatively warm sea water on all sides but one. The winters are so mild that ice over an inch thick is seldom seen. Potatoes may be planted in December, and the plow can run every month. The hard land is only about five miles wide, and is flanked on each side by sea-meadows, sea-marshes, and lagoons or sounds, that are from three to five miles wide. These sounds abound in fish, oysters, clams, mussels, and the king-crabs, of which a valuable fertilizer is made. I never saw land that could so easily be brought up and made of the highest fertility. The natural soil is a light yellow clay mixed with gravel, with oak as its natural growth, and having sandy streaks or belts where pine prevails. In the lower lands there is great store of black muck, and the timber is cedar, not surpassed in lasting qualities, and in quantity sufficient for fencing, the more exposed timbers of buildings, and shingles. What impressed me was the ease with which those situations can be made as fertile as any farms in New Jersey or any State. Most of the tracts extend from the ridge in the center of the tongue to the marshes, giving three or four grades of land, the dry clay and sands of the ridge, the stronger soils just above the tide-line, and the black and blue muck of the marshes. By drawing this muck, the weed tossed up by the tides, and the rough grasses that grow on lands wet by the tides, to their barnyards, these farmers can make four times as much manure as they would if they took no such pains, and this compost would be just as good as droppings alone. Millions and millions of king-crabs come up every spring on the west side of the peninsula to lay their eggs. From 500 to 600 tons of a very rank manure are made by crushing these animals in a coarse mill. The cancrine has from twelve to fifteen per cent of ammonia, and is a very quick and stimulating fertilizer; but I was surprised to learn that not a ton of the 600 tons made is used by the farmers nearest the water and the mill. Fifty dollars, and in many cases less, per acre, will buy one of these admirably situated farms, and half of them are in market, for the inhabitants are a seafaring people, and think farming never pays.

SMUT, HOW PREVENTED.

Mr. George Orr, Licking, Mo., says his Club have been discussing it, and wish him to come with an inquiry to the Farmers' Club. Their wisdom has settled down on four rules: First, secure good seed; second, soak with bluestone water; third, observe a proper rotation of crops; and, fourth, change the seed every three or four years, by procuring from a different soil. These precautions, we think, will at least partially prevent smut; but we should like to know the cause, if possible.

Mr. F. D. Curtis.—Smut is a fungus, superinduced by the character of the seed, the condition of the atmosphere, and the soil, or one, or all. Hence, good seed is important, as a preventive, and a change of soil. If smut appears in a crop of wheat, I would not sow seed from it if other seed could be procured, nor would I succeed that crop with another of wheat, but grow my breadstuffs in another field. Soaking the seed in lime-water is said to kill the smut. It is a good practice anyway, and during the operation the light seed and foul stuff rising on the top ought to be skimmed off. The seeds of smut are the spores of the fungus, which can be transmitted, and will grow in favorable circumstances, just like chess or any other vegetable production. In answer to the question, what makes smut grow, I can only say, the same Being who makes us all grow.

Mr. H. L. Reade.—Since the subject of seed wheat has been mentioned, let me say that the farmers of this country do not have as much care in the choice of their seed corn as would be to their gain. A man of my acquaintance used to pick the best ear at the time of husking, from each stalk that had produced two, and, with care in keeping, his corn always came up well; and, what is better, he raised, for thirty years, several more bushels per acre than his neighbors, although the soil in his farm was no better. If farmers would carefully select their seed this autumn, and see that it was carefully cured, they would have less trouble next spring, and a larger crop next autumn.

Mr. J. W. Gregory.—Copperas-water is better than lime-water, and brine as good as either. In England, urine is the soak.

SOAP-MAKING.

George E. Dowd, Bridgeton, N. J., writes of his experience: I undertook to make soft-soap by using grease, eight pounds; caustic soda, eight pounds, and sal soda, one pound, and soft-water, forty gallons. I cannot make the chemical union perfect, and it will separate in spite of all I can do. I have also run off lye from hickory ashes with lime in the leach, and boiled it up with that, but with no better luck than before, except the soap being stronger and washes better, but it will separate as before, and the flies will blow it. Will the adding of borax or more sal soda be of any use to prevent separating, or what can I do with it to make it unite? It is not soft like soap made from ashes alone, but hard like liver.

Prof. J. A. Whitney.—Caustic soda makes a hard-soap, and caustic potash a soft-soap. Sal soda, which is a carbonate of soda, will make neither; it is a hurtful ingredient in the alkali, which soap-makers take care to remove by leaching through caustic lime, which takes away the carbonic and converts it into caustic soda. The sal soda is probably the cause of the mischief, which will cost more to repair than the soap is worth. Borax is a cleansing substance of itself, but will pay better used alone than mixed with the spoiled soap.

COTTON-SEED CAKE.

Several correspondents would know about this article. S. B. Cook, Orange county, N. Y., asks: How should it be fed? What is its value compared with linseed eake? Where can it be obtained? What is the price per ton?

Prof. H. E. Colton.—It can be bought at No. 4 Front street, New York, and almost any commission merchant will send it if ordered. It can be bought in the form of meal, or in the cake, and the buyer grind it himself. Price, thirty-five dollars to forty dollars per ton. When in meal it is fed mixed with hay, bran, slops or other feed. It compares with linseed as follow: Cotton-seed cake contains seventy-five per cent nutrition; linseed cake contains seventy and one-eighth per cent; best hay, fifty-eight per cent. The great cheapness of this article, and the inexhaustible supply, make it an object of interest to our farmers. It has long been used in England.

Adjourned.

September 27, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

MANURE FROM POULTRY YARDS.

Mr. I. V. Nutter, East Bridgwater, Mass.—In my visits to places where fowls are kept, I have noticed how great a loss is incurred by the carelessness of many in regard to the droppings of the fowls while at roost. Poultry when confined, I judge, pass two-thirds of the time upon the roost, and by a little care and trouble a great deal of valuable compost can be made, even from a flock of a dozen fowls. Two years ago I made in my henery a platform two feet wide under the entire roost, putting up boards at the sides and ends one and a half feet high, thus making, as it were, a large trough. I then covered the bottom with dry earth two or three inches deep, and occasionally with a hoe or spade mixed up the earth with the dung accumulated, continuing to add fresh earth and a small quantity of plaster every two or three weeks. The result has been, that each spring I have had a number of wheelbarrow loads of excellent compost, equal if not superior to guano, by the use of which I have been enabled to produce in my garden a good crop of fine melons, squashes, sweet corn, and tomatoes; in fact, the best vegetables in my garden grew where I used this compost. Although the season has been unusually dry, I last week gathered eight good-sized watermelons from five hills of the "Phinney" variety, the two largest weighing nineteen and a half and seventeen and a half pounds respectively. None of my neighbors who used barn manure had any nearly as large. In the autumn I have a quantity of dry earth placed in a corner of the henery, near the roost, and from this pile I find it but little trouble to throw what is needed under the roost.

Professor J. A. Whitney.—This is a good way to save and apply the refuse of the hen-roost, but the compost cannot be equal to guano. Ordinary hen manure alone may be considered equal to Peruvian guano, and its comparative value will of course diminish in proportion to the per centage of earth mixed with it. The great advantage of composting is to dilute the concentrated fertilizer so that it will not burn the plants, and so that it may be more thinly and uniformly applied.

Dairy Farming in the Western States.

Mr. O. P. Lanning, Wellsboro., Pa.—Having seen it stated that Kansas and Nebraska are not considered good localities for butter and cheese, on account of climate, scarcity of cool running streams of water, and grasses not possessing proper elements for good flavored butter and cheese, suitable for New York market, would ask the Club if these impediments to western dairying cannot be overcome by adopting the soiling system.

Mr. A. S. Fuller.—Soiling would, without doubt, do somewhat toward obviating the difficulties experienced in a country where the most nutritious grasses do not succeed. The question is not whether butter and cheese cannot be made, and of good quality, but can it be done with profit? Dairy farming has not been thoroughly tried at the far west; therefore it would be anticipating experiments in this line to say that it could or could not be made a profitable business. When our best grasses have become abundant, or even extensively experimented with, it will be time to express an opinion as to the capabilities of Nebraska and Kansas for dairy farming. It would be very strange if there were not extensive tracts of country in the above named States that were as well adapted to dairy farming as can be found among the sterile hills of New England.

THE ATTRACTIONS OF CALIFORNIA.

Dr. J. V. C. Smith.—The lands of California are divided into great tracts of several hundred and several thousand acres. They are called ranches rather than farms, and it is difficult for a person to buy a small and at the same time a valuable piece of land. But the capacity of the valleys for yielding crop after crop of the most important plants cultivated by man is quite amazing. The yield of wheat is very large, and the quality above the average growth of any other region. So of grapes, and especially wine grapes. While there the committee met a number of the representative men of that slope, and they spoke to us freely of the attractions and resources of their land. From their statements we were enabled to form a judgment as to what branches of industry will be likely to prosper most. 1. The wool industry is now flourishing. Sheep may be clipped twice in a year, and they can be wintered with very little fodder, almost none. 2. Wine.—It is easy to raise from one to two tons per acre, and to make a gallon from each fourteen pounds of grapes. If the wine is well made and kept for some years, it should sell for one dollar per gallon. The Port of California is excellent and destined to become the most valuable wine. 3. Grain Growing.—As before stated, California wheat is produced with little risk, and comparatively little labor. The valley lands are very slowly exhausted by successive crops, and irrigation is not found necessary for wheat. 4. Special Tropical Crops.—The olive prospers in California, and some of the committee at the gardens of General Vellejo, in Sonoma Valley, saw ripe figs, growing oranges, ripe pears and apples, and grapes hanging on trellis, and showing from fifty to 100 pounds to each vine. Close by we saw the mulberry, and were informed that silk culture is eminently prosperous. On the other hand, as to fruits, it seems quite certain that the business is overdone. We saw bushels and bushels of good summer pears fed to pigs, and the yield of one great orchard of 10,000 bushels was sold at $100. Another element that now disturbs industry in California is the heathen Chinee, whose ways are peculiar. There is a strong and growing dislike of him, which is likely to result in his expulsion. If driven from that shore we have no doubt the Atlantic slope will welcome him and greatly prosper by his advent. Nor is it by any means certain that after John has left the laborer will get, as he expects to, his three dollars and four dollars a day for unskilled work. No one can visit the region without being greatly impressed with the magnificence of the enterprise that scaled the Sierras and dared to lay an iron rail 8,000 feet above the sea level, and to take great loaded trains along those sombre gorges and across such yawning chasms. But we think nothing will so benefit and build up that interesting country as to multiply the avenues between the two slopes. California needs the foot of the patient, regular, homestead farmer, the man who tills all he owns, and owns all he tills; who is willing to labor the twelvemonth on a hundred acres, and can prosper and become affluent by taking from his surface not wheat alone or wool only, but olive oil and silk cocoons, dried figs and fresh oranges, and the genuine, unadulterated blood of the grape.

Split Bark on Apple Trees.

Mr. A. B. Van Namee, De Witterville, New York, has several apple trees the bark of which is split from the surface of the ground up eight or more inches. Upon examination, he found the bark loose nearly or quite around the trunk, and now many of the trees are dying.

Mr. A. S. Fuller.—The bursting of the bark of thrifty young apple trees in winter is a very common occurrence in the western States. The richer the soil and more vigorous the trees, the greater liability to injury. It is not the degree of cold to which trees are subjected that causes the bark to burst, but it depends entirely upon their condition or power of resisting it; hence we find as many trees injured in a mild winter as in a severe one. Trees that make a little growth in autumn appear more liable to be affected than those which ripen their wood early. We may not always be able to prevent the bursting of the bark, but after it has happened, a larger portion of the trees may be saved if attended to in time. In early spring, just as soon as the bark is found to have burst, put a bandage of some strong material about the stem, and press the bark into its original position; but before doing this, apply grafting wax or clay to the open wounds, so that when pressed together all air will be excluded. New bark will usually be formed during summer on the inside of the old, and a permanent union effected with the wood. The bandages may be removed in midsummer, or as soon as a union has taken place. We have ourselves saved many trees in this way, and there is little danger of losing a tree with bursted bark if it is taken care of at the proper time.

Pears from Vineland.

The chairman spoke of the exhibition of fruit now being made at the Institute fair, and mentioned some pears from Vineland, N. J., as especially worth seeing. They were placed, he said, by Mr. Thomas Grigg, and, that gentleman being called for, explained that they grew in the sands, and that they were kept entirely free from mark of insect, because the people there took Dr. Trimble's advice, and practiced the jarring process.

Sparrows.

Dr. Isaac P. Trimble made some remarks about these birds, saying in effect that it is vain to expect them to rid our ground of fruit pests, or even to do much of anything in that direction. The Palmer bird is ten times more valuable, being entirely insectiverous. Mr. Cavanagh said that the good folks of the city of churches thought they were doing a large thing when they gathered sparrows in large numbers and let them loose in the parks; but time, which proves all things, has proved that these birds are wanting in all that would make them worthy of our esteem. The day will come, he continued, when those who put up fine houses for them will wish they had their greenbacks back, and that they were well rid of the grayback.

Permanent Water-pipes.

Mr. C. H. Graham, Schenevus, N. Y., asked, what is the best material for piping, and what would be the cost per foot or rod? Is there not a glazed earthen tile, which would be better and cheaper than lead?

Mr. P. T. Quinn.—Glazed earthen will peel and crack after awhile. Lead should by all means be discouraged. When water stands on lead, the carbonate of lead is produced, which is a slow poison.

Prof. J. A. Whitney.—If our correspondent wants a durable pipe he should take iron, which is most lasting of any, and never injures the water. There is no advantage in having galvanized iron pipe.

In fact, for some months, a galvanized iron pipe is as bad as lead or worse. There is a cement pipe which does very well where the fall is moderate, but he speaks of 100 feet fall in 200 rods, with valleys intervening. I think they are shut up to iron if they want a good pipe.

Ashes of Tan-bark.

A correspondent writes to inquire whether they are of value as fertilizers.

Dr. Isaac P. Trimble.—I once knew a farmer who owned a tannery, and in the course of years a large heap of spent bark accumulated. It did not rot and become available in that way, so he fell into the practice of burning it, and he told me he thought he proved by experience that the ashes thus obtained were worth about as much as wood ashes.

Mr. H. L. Reade.—I suppose that such part of the substance of the bark as is used for tanning does not take from the value of the refuse when reduced to ashes.

Mr. J. B. Lyman.—This question was carefully looked into a few years ago in Germany. I presume our correspondent refers to oak tan-bark. If he does, he can be sure that its ash is as good if not considerably better than the ashes of oak wood. The ash is about one-twentieth of the dry bark in bulk; that is, a cart load of twenty bushels bark will burn to a bushel of ashes, and of that bushel seventy-five per cent or three pecks, is potash. But oak wood gives considerable carbonate of lime in its ash, while the bark yields very little. As potash, however, is much the more valuable substance, I would advise him, by all means, to burn his tan-bark, and in using it, to mix lime with it.

On the Application of Ashes.

Mr. S. H. Murray, Livingston, Me., would know whether it makes much difference at what season of the year wood-ashes are used for top-dressing grass lands; also, "What is the relative value of leached or unleached ashes for this purpose?"

Prof. H. A. Colton.—The latter part of winter or the earliest days of spring would be best for several reasons: 1. You are likely to have most ashes then. 2. The rains will soon come and incorporate all the valuable matter in the soil. 3. You get very soon the value of your ashes. If put on in the fall the snows of winter are apt to absorb some of the potash, and, chemically decomposing it in melting, to throw it off in the atmosphere as an ammonia. Leached ashes are undoubtedly the most economical for the farmer, as, by mixing quick lime with his ashes, he gets a good caustic potash for soap, and also improves the ashes for his land. Unbleached ashes probably act quickest, and if mixed with plaster, are apt to return all their value.

BROOM-CORN SEED FOR CATTLE.

Mr. H. C. Loose, Hagerstown, Md., asked concerning "the value of broom-corn seed for grinding and feeding cattle; what would it be worth with corn at ninety cents per bushel, oats forty-eight cents, and rye eighty cents?"

Mr. H. L. Reade.—Unquestionably the best way to dispose of broom-corn seed is to feed it to fowls. The next best mode is to give it to sheep; they are fond of it, and fatten upon it nearly as fast as on Indian corn. Ground with corn, rye, oats or barley, it is profusely fed to cattle, and when mixed with wheat-bran it is good for milch cows. The Shakers frequently feed it to horses, and at the season of the year when this grain is not only abundant but at hand, they use it exclusively. My judgment is that with corn at ninety cents, oats forty-eight cents, and rye eighty cents, for grinding and feeding to cattle broom-corn seed is worth between fifty and sixty cents a bushel, although it would be more valuable to dispose of it in some other way.

CURING SOWED CORN.

Mr. Cameron McVean, Scottsville, N. Y., writing on this subject, said: I take a common grain cradle and cut off eighteen or twenty-four inches of the scythe in proper shape, and the fingers to match, and cradle the corn as I would wheat, leave it in the swathe till well wilted, then bind in small bundles and shock, leaving it till well seasoned; then put away in lofts or top off other stalk stacks, and it will keep in good order.

Mr. H. L. Reade.—This practice would not answer at all well in some localities I wot of, where sowed corn frequently grows eight to ten feet high.

CHEAP PAINT.

Mr. William B. Curtis, Mercer county, N. J., says: We desire a cheap paint for outbuildings. Will crude petroleum, mixed with Spanish brown or yellow ochre, make a good paint for that purpose? Will crude petroleum alone preserve cedar or cypress shingle roofs?

Mr. William Lawton.—I do not believe there is any cross or middle ground for common structures between good white lead and linseed oil on one hand, and good whitewash on the other. For outbuildings I like whitewash. By using salt and glue or sour milk instead of water, it sticks. Crude petroleum is an excellent wash or paint for out-door work where the bark is left on. But petroleum is not a painting oil. Many buildings are covered with a brown or slaty wash, in which water lime or cement lime is used. This gives the building a sort of mineral crust or cement, which keeps out the wet. But quick lime is a better preservative.

Planting Celery.

Mr. P. T. Quinn.—The time of planting is varied, according to the disposition to be made of the crop. The season is from the 20th of June to the 1st of August. Celery planted on rich ground before the 20th of July can, under favorable circumstances, be grown large enough to be banked, bleached and sold in the later part of October and through the month of November. Celery will succeed best when planted in a deep, rich, sandy loam, which has been well pulverized before planting. The old-fashioned system of making deep trenches with the spade in which to plant celery, practiced extensively twelve or fifteen years ago, has been abandoned of late years by the progressive market gardener as a useless expense, without a single redeeming feature. It is found by experience that celery will do very much better when planted on the surface, making a much quicker and larger growth when planted on the surface of the same quality of soil, and at the same time saving all the unnecessary expense and labor of digging the trenches for celery. This in itself was an important move in the right direction, increasing the products of the soil by a system which tasks the brain of the gardener as well as the muscle; or, in other words, physical strength in a properly managed market garden must become subservient to systematic and maturely developed plans of the manager. When any of the crops mentioned are removed and marketed, the ground is plowed deeply at once for celery. The surface is made fine and mellow by the harrow. In case the soil turns up rough, owing to heavy rains or continued dry weather, a light roller run over the surface will facilitate the work and lessen the expense of crushing the lumps and leaving the surface level and smooth, ready for planting. In the small kitchen garden the same conditions of depth and tilth must be brought about by the use of the digging fork, spade and hand rake.

If the ground intended for celery was not liberally manured in the spring, and any doubts entertained about the fertility of the soil, it is well to add a heavy dressing of well rotted barn-yard manure spread broadcast, and plow or fork it under before planting. It is a waste of time and money to attempt to grow celery, either for pleasure or profit, on poor soil. By the aid of the garden line and "marker," the rows are marked out three feet apart, and as straight as possible, for there is nothing in the vegetable garden that will give a more careless appearance than crooked rows of celery. It is a good plan before planting to sprinkle along the lines of the intended rows of celery some wood ashes, fine bone-dust, or superphosphate, either of which should be mixed with twice their own bulk of soil before application. When applied in this way, the young plants get a good start early in the season, which is very desirable in growing celery for market. It is better under all circumstances to select damp or wet weather for transplanting celery. Gardeners have to frequently resort to watering and covering the plants in case the weather sets in dry and hot soon after transplanting. In pulling the plants from the seed-bed it is well to get them of uniform size, so that the growth in the garden or field, under good treatment, will be about the same. Both the roots and leaves of celery plants should be "trimmed" before planting; that is, the plants are taken in handfuls, and with a sharp case-knife a portion of the roots cut off, leaving about two inches and a half, and all the outside leaves cut off even with the top of the hearts.

They are then set firmly in the rows with the "dibble" about four inches apart, and never any deeper than they were in the seed-bed. In case the weather should set in very dry and hot immediately after planting it would be advisable to water the plants a few times, about sun-down, and protect them from the direct rays of the sun by covering during the daytime with brush, rhubarb leaves, or by nailing two boards together, the end view of which would resemble the letter A, and placing this wooden structure over the plants in the row; it will keep the ground moist enough to start the plants growing in a few days.

If the ground is moist at the time of planting, or the weather keeps cloudy, there will be no occasion for either watering or covering the plants. These precautions are only put in practice in case of continued dry weather, which always more or less injures celery recently transplanted.

During the early stages of growth, the only thing to be done is to keep the spaces between the rows disturbed frequently. This in field culture can be done at a much less expense by horse than man power. In garden culture, the hand-hoe and rake are the only tools required for a month or six weeks after planting.

When the celery has grown twelve or fifteen inches long, the earth on either side of the row should be loosened a couple or three inches deep with a cultivator, subsoil plow, or the hand-hoe. It is then ready for "hand handling," which should be done with care.

This operation is simple, but requires some practice before much headway can be made. The operator gets down on his knees and gathers all the leaves of each stalk up, and while holding them in position with one hand, presses the loose earth against the stalk with the other, and then *vice versa*, going in this way over the whole row, and each row in turn. When this is finished, the earth is thrown toward the celery from both sides with a one-horse plow, in field culture. A man usually follows with a hand-hoe, and draws the earth still closer to the celery, where the plow missed or failed to do the work well. In the garden the hoe is made use of instead of the plow. As fast as the celery grows the earth is drawn up by men with hoes, until the time for banking, in order to make the hearts white, or "bleaching," as it is usually termed by gardeners. This operation is more tedious, and to do it well, calls for a person who knows how to handle the spade. A man stands on either side of the same row of celery, commencing about ten or twelve inches from the celery in the row, a straight bank of earth is raised up by either man, covering all the celery except about three or four inches of the ends of the longest leaves. Each man endeavors to build his side firmly and straight up and down, and it is usually a matter of considerable pride among practical gardeners, on their ability to bank celery well.

This walling up the celery begins about the middle of September, and when celery is grown on a large scale, as it is in the vicinity of New York, this banking continues until cold weather, especially for all the celery intended for sale during the fall or early winter. The portion intended for sale after the holidays is not usually banked in the way described, but put in winter quarters, when the same results are brought about; the only difference is in the time, which is in favor of fall banking. In drawing earth toward the celery, or banking with the spade, it is very important that the hearts should be kept straight, and not broken or in any way injured by carelessness.

Formerly there was, as a general rule, a very large per centage of loss in keeping celery during the winter. The hearts are very tender, and they rot easily when buried in the old fashioned style. Of late, gardeners in this vicinity have hit upon a much more simple and better method of keeping celery, which can be availed of by the private, gardener or farmer as well as the professional market gardener.

In the northern and middle States, celery is usually taken up from the 1st to the 20th of November. At our place the earth is thrown from the rows with a large sized single plow, and then by following with a lifting subsoil, the stalks are all loosened without the aid of the spade. The stalks are then pulled up, some of the earth shaken from the roots, and left in heaps along the row. In the meantime, a trench is opened in some convenient spot, ten inches wide and about fourteen deep, leaving some loose earth on the bottom of this trench. It is always better to make the trench where there is a natural fall for the water to run, especially on clay ground. The celery is carried to the edge of the trench, and beginning at the upper or highest end of the trench. The celery is placed in an upright position in this trench, packing it close together until the whole trench or a number of them are filled. As the weather grows colder, the earth is drawn from either side toward the celery, and when finished the celery stowed away looks like a single row banked up.

The bleaching process will be hastened by pressing some fine earth in alongside of the celery stalks at the time of stowing the crop away.

The tops are preserved by covering them with a coating of long manure, or an abundance of salt hay, or any other litter, when put on in sufficient quantity. The boards described for protecting the plants from the sun can be made use of for this purpose, and will be found serviceable. The front of such a pit or trench can at all times be opened, with but little trouble, even in very cold or inclement weather. It is, in fact, the best method for keeping celery during winter that I am familiar with, and market gardeners in the vicinity of New York think better of it than any other method. In case the bleaching goes on slowly, it may be hastened by removing the covering and pouring a stream of tepid water into the trench. The hay, manure, or boards should then be replaced at once, to prevent the frost from injuring the leaves of the celery.

When celery is planted at the distances named in this article, there can be grown from 30,000 to 35,000 stalks on an acre. If the stalks attain full size, they are worth, taking one year with another, thirty dollars per thousand.

This looks like a large amount, and it would, if there were no losses or heavy expenses in producing the crop, which may be marked dowr as one of the most expensive and troublesome that the market gardener has to deal with. When the gardener is located near a good market, and with a favorable year, celery will pay a very handsome profit.

Pear Culture for Profit.

Mr. P. T. Quinn, of Newark.—I have made a careful estimate, and now feel quite confident that I will have 1,200 bushels of marketable Duchesse d'Angouleme, and I have good reasons to suppose that this is a larger number of bushels of this variety than have ever been produced from one orchard in a single year in this State. The Duchesse are now selling for five dollars per bushel, and I think will advance in price later in the season. This estimate does not include our crop of Bartletts, Seckels, Beurre Clairgeau, and Vicar of Winkefields. The aggregate number of bushels of these varieties I have not as yet had time to make a careful estimate. I would state, however, that more than three-quarters of the trees in the orchard are of the Duchesse variety.

Mr. D. B. Bruen.—I have seen Mr. Quinn's orchard, and it was certainly a most remarkable and gratifying sight. One of the best points in the practice which has brought so satisfactory results, and which he tells us all about in his little book, is his habit of mulching the trees. His soil is a heavy red clay, abounding in small flat stones. It was one of the hardest of soils to subdue and slow to fertilize, but he is now reaping the harvest of long industry and generous outlay for manures. I don't suppose there is another orchard like it in the country, and manure and deep plowing has made it.

Adjourned.

October 4, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Experiments with Potatoes.

Mr. Isaac Hicks, N. Hempstead L. I.—Last spring I tried some experiments to prove, if I could, what size of potato yielded the most per plant. The ground was all alike, and manured alike, in drill with stable manure. The first experiment was with tubers one and one-half inches in diameter, whole, two rows. The next of largest size potatoes, whole, two and one-half inches diameter, two rows. Third, large potatoes, cut in pieces, leaving two or more good eyes to each piece. Fourth, large potatoes, with all the eyes but one dug out with a knife. Fifth, largest size, whole, after they had grown two or three inches above ground, all the shoots but one, the strongest, pulled out. They were kept clean, and when dug yielded above 140 bushels to the acre. Variety experiments with peachblows, the whole and largest size potatoes, with all the eyes but one cut out, yielded nine bushels of potatoes on the same amount of ground, or the length of rows dug and measured where those that were cut and those that were whole, one and one-fourth inches in diameter yielded eight bushels, or a gain of one bushel in eight, did not pay for loss of labor and seed. Those planted, and afterward all the shoots but one pulled up, gave one bushel in ten less, and the rows where all were allowed to grow from the largest potatoes planted had the most small potatoes, and the yield was not as good as where cut. Conclusion: Large potatoes cut in pieces were the best. The majority of the farmers in the town of North Hempstead, on Long Island, raise from four to fifteen acres of potatoes for market. We are anxious to discover the best and most profitable method of growing them on our soil. Some of us are frequently trying experiments to prove which is the best, and purchase more or less of the honestly and dishonestly made fertilizers that are offered. The result of every experiment we have heard, and the universal heard, is, that large-sized potatoes cut into from two to four pieces are the most profitable, and the little potatoes are either fed out, or sold to the bakers to put in their dough and improve the bread. Good stable-manure will give the food the potato-plants require cheaper than any patent fertilizer we have used. Manure is very dear, but the elements of plant food are yielded to us at less cost and more benefit to after crops from it than any other manure or fertilizer yet tried in Queens county. Sometimes newly cleaned, or old and long neglected lands, when brought under good cultivation, plowed deeply and frequently stirred,will, by the decay of the vegetable fiber of the sod, and the action of the air and light on the freshly turned and stirred soil, yield very good crops for a few times with the application of small quantities of fertilizers, such as guano, bone-dust, ashes, and other mineral agents, but our experience is that it is not lasting. Recourse must be had to the process of returning to the soil, as near as may be, the same materials as we drew from it, and that is found in the manure from our domestic animals; horses, cows, hogs and sheep, better than in any other thing. We have heard occasionally among us, of some great success made, by reversing our old and long tried methods, but in a few years they are heard no more; it was but as a flashing meteor, and soon disappeared.

Mr. Gerard C. Brown, Croton Falls, N. Y.—I have the honor to submit to the Farmer's Club, the inclosed report of experiments with fifty varieties of potatoes, arranged in tabular form: They were all planted by April 16th, 1870, on a rich alluvial loam, well composed in the hill and thoroughly tilled. The hills were three feet one inch, by three feet six inches apart. You will observe that the very earliest ripening kinds did the best, except the No. 2 and the White Chili, the latest of all, owing without doubt to the drouth, which seriously affected the entire product.

Order of maturing.	KIND.	Number barrels of seed to acre.	Yield to acre, in barrels.	Yield in barrels to one of seed.	Number of hills to barrel.	Per centage rotten.	QUALITY.			Price per barrel.
							First.	Second.	Third.	
1..	New Hampshire	2	50	25	80	......	....	1	....	....
2..	No. 4 (or King of the Earlies)	2	80	40	50	......	1	....	....	$10 00
3..	Early Rose	3	63	21	63	.01	1	....	....	4 00
4..	Early London White	3	59	19⅓	70	......	1	....	....	6 00
5..	Early Snowball	2½	55	23	72	......	....	1	....	5 00
6.	Early Mohawk	2⅓	50	20	80	......	....	1	....	5 00
7..	Ketchum Seedling	2⅓	60	26	66	......	1	....	....	10 00
8..	Early Queen	3	51	17	79	... ..	....	1	....	5 00
9..	Excelsior	2¼	72	33	55	......	1	....	....	6 00
10..	White Sprouts	4	45⅓	11	88	......	....	....	1	2 50
11..	Sebec	3½	40	12	100	.05	....	....	1	2 50
12..	Dyckman	4	44	11	90	... ..	....	1	....	3 00
13..	Goodrich	3½	45½	14	88	......	...	1	....	3 00
14..	Garnet Chili	4	52	13	77	......	1	....	....	3 25
15..	Willard	2½	52	22½	75	......	....	1	....	5 00
16..	Monitor	4½	66	15	60	......	....	....	1	3 00
17..	Buckeye	4	35¼	9	112	.03	....	....	1	3 00
18..	Climax	3	80	27	50	......	....	1	....	5 00
19..	Samaritan	3	31	10⅓	130	......	....	1	....	3 50
20..	No. 2 (or Breezee's Prolific)	2½	91	40	44	......	....	1	...	5 00
21..	Forfarshire Red	4	50	12½	80	......	....	....	1	2 50
22..	Jackson White	4	44	11	90	......	....	....	1	2 50
23..	White Mercer	3½	17	5½	240	.07	....	....	1	2 50
24..	Black Mercer	3	25	8	160	.05	....	....	1	2 50
25..	Skerry Blue	2¾	11	4½	360	......	....	....	1	2 50
26..	Holbrook	4	44	11	90	......	....	....	1	2 50
27..	Harrison	4	47	11¾	85	......	....	....	1	2 50
28..	English Kidney	4	50	12½	80	......	1	....	....	3 50
29..	Orono	3	41½	14	96	......	....	....	1	3 00
30..	No Blow	3	40	13⅓	100	......	....	1	....	3 00
31..	No. 6 (or Peerless)	2	83	41½	48	......	1	....	...	12 00
32..	Darien	4	50	12½	80	.10	...	....	1	3 00
33..	Dyrite	4	50	12½	80	......	....	1	....	3 25
34..	Prince Albert	4	44	11	90	......	...	1	....	3 00
35..	Strawberry	4	50	12½	80	......	....	....	1	2 50
37..	Vandeveer	3	71½	23	56	.....	1	....	....	5 00
38..	Coppermine	3¾	44	11	90	......	....	....	1	4 00
39..	White Eye Rustycoat	4	40	10	100	......	....	...	1	3 00
40..	Pink Eye Rustycoat	4	44	11	90	......	....	1	....	3 00
41..	Calico	3¾	32	10	125	......	....	1	...	3 00
42..	Andes	4½	66	16	60	......	....	....	1	3 00
45..	White Peachblow	4	52	13	75	......	1	....	....	4 00
46..	White Eye Peachblow	4	71½	18	56	......	1	....	....	6 00
47.	Red Peachblow	4	51¼	13	78	......	....	1	....	3 50
48..	Gleason	4	60	15	67	......	....	1	....	3 25
49..	Cusco White	4¼	53	13	75	.01	....	....	1	2 50
50..	Chili White	3	114⅛	38	35	......	1	....	....	7 50
	IMPORTED.									
36..	Bermuda	....	40	....	100	......	....	1	....	....
43..	Leathercoat (from Ireland)	....	28½	....	140	......	....	....	1	....
44..	Greentop (from Ireland)	....	40	....	100	......	....	....	1	....
	Sweet	....	66	....	60	......	....	....	....	....
	Average	3½	57	16⅓	70	$\frac{1}{2000}$	11	19	20	$4 00

REPORT ON THOMPSON'S GREEN ISLAND GRAPES.

Mr. Frank D. Curtis, chairman of the committee appointed to visit the vineyard of Mr. David Thompson, at Green Island, near Troy, N. Y., submitted the following report:

We visited the vineyard on the 15th of September. The grapery of Mr. Thompson is situated about 200 feet from the Hudson river, on a level table or plateau, twenty-five feet above the bottom of the river. One branch of the Mohawk river flows down in the rear, emptying into the Hudson below. The valley of the Hudson is here about one and a half miles wide, flanked on either side by hills, those on the east, the highest, back of the city of Troy, rising up 200 feet above the river. The natural soil is gravelly, the alluvial deposits being worked out and deposited on the flats down the stream. The soil in Mr. Thompson's garden has been enriched with sawdust, coal ashes, lime screenings, and the waste of the kitchen. The ground is dry and warm, but possesses no special or peculiar characteristics. A high board fence surrounds the garden, Mr. T. says, as a protection against marauders. The spot is small, 200 feet by sixty. On this limited ground — about thirty-seven degrees north latitude — there are growing 300 bearing grape vines—a labyrinth of vines, leaves, and clusters of fruit which we have never seen excelled on such a crowded space. Mr. Thompson is a Scotchman by birth, and was formerly gardener to Lord Beresford, in the north of Ireland. He has lived forty-three years in this vicinity. He claims that his grapes are all seedlings of his own production, and thus far he has received no pecuniary reward for his labors. We shall describe in this report the exact condition, and appearance, and character of a number of the leading varieties of grapes as we saw them hanging upon the vines at the time of our inspection. In the entire ground we did not discover any traces of mildew or wet, but on the contrary, every vine appeared healthy, unless sunburn might be called a disease. Our attention was called to several prune trees heavy laden with perfect fruit, which Mr. T. has cultivated for nineteen years, and which he thinks would grow in any garden tolerably well protected. They are now growing in Troy and Waterford. The curculio has never disturbed them.

The first grape we inspected was the William S. Carpenter, a cross of the Hamburg and a grape imported by Mr. Thompson from Palestine, which he calls his "Mother" grape. The "Carpenter" resembles the Hamburg in size, form, taste and color. The vine, two years old, stood in the open ground, and with its sixteen clusters of grapes and twenty-one feet of growth, eighteen feet of which was well matured, demonstrated that it was a hardy and vigorous vine. Mr. Stewart said this grape was doing well with him at Lebanon. The grapes were ripe and delicious. The "David Thompson," a cross of "Carpenter" and the "Grant" grape, had clusters, by actual weight bringing down the scale at two and a half pounds. The berries were very compact, as large as the Concord. The vine was four years old from the seed. The canes were strong and large; one cane, eleven feet and nine inches from the root, had been broken off, and at the end a new shoot had started out with a setting for a new and promising cluster. The vine gave evidence of strong productive qualities, and although not fully ripe the flavor was thought to be a little better than the "Carpenter." Capt. Tupper said that in his opinion this was the eureka of grapes. The "General Grant," one of the parents of the last-named grape, was white, four years old from the seed. This is a seedling from the Mother grape, which was also white. Mr. Stewart has it growing at Lebanon, in an exposed location, and it is healthy and vigorous. The grape was quite sweet, but not fully ripe. The clusters were large, with full shoulders, and fruit closely set. Some of them were nine inches long. At North Adams it grows well. The "L. H. Tupper" was dead ripe, very sweet, and pleasant; cross of Roger's No. 19 and Allen's hybrid, dark purple, small clusters, with a large berry, vine four years old, wood ripened to the ends; been ripe two weeks; an excellent grape. "Nathan C. Ely" was a white grape, three years from the seed; wood matured nearly to the top; very strong and firm leaf; mammoth clusters. The "Ely" was commended. A new seedling, which we named the "A. B. Crandell," was dark purple, a heavy bearer, with a large crop now on the vine, which was four years old. The "Crandell" was a superior grape and fully ripe. The "Bontacue," vine three years old, grapes dark purple, wine ripe and sweet, clusters long and full; this promising variety had at least 100 pounds of grapes on the vine, and last year had a heavy crop; remained on the trellis all winter. "Early August," small berry; ripe for three weeks; a good bearer and a good grape. "William Tell," exceedingly sweet; ripe about two weeks ago; small berry, an extra bearer; the birds were so fond of this grape that Mr. Thompson was obliged to cover them. The "Lavena" had a large berry, with heavy clusters; it is black, healthy, and strong; been ripe two weeks. It is wonderfully prolific, and is a better grape than the Isabella. One vine hung on a stake presented a continuous line of grapes for the hight of six feet, the clusters hanging upon and overlapping each other. The "Elanor" has been cultivated ten years. It is a dark purple, large and heavy clusters, oblong in shape. The vine has had no care, and the fruit has been ripe for more than two weeks, and was excellent. Capt. Tupper said the "Elanor" was a perfect success with him in Troy, and sweeter than Mr. Thompson's. The Captain's soil is clay, with which he has mixed sand. Mr. Fitchet had them, and showed a cluster weighing eleven ounces, fully ripe. At this date Isabellas were not ripe in Capt. Tupper's yard, and would not be before the 20th. The "James M. Ketchum," dark purple, had been ripe for two weeks. This grape will dry on the vine like a raisin. Several white grapes without name were shown of excellent quality, one of which had a fine crop of berries almost transparent, with clusters shouldered and fruit closely set. Mr. Thompson thought this his best white grape, which he named "The Farmers' Club," and recommended it for general trial, as it promises well.

Mr. F. D. Curtis.—In the report I spoke as a committee man. As a farmer and fruit-grower I wish to say in addition that I think the honor of the Club and of society is due to Mr. Thompson for these long continued and at length successful efforts to give us better grapes. He has worked in the spirit of an enthusiast, and has sought no reward in money, nor does he hope for any reward but the approval of those who honor the cause of horticulture.

Others made similar tributes, and the vote of thanks was unanimous and very grateful to the veteran gardener.

HAWLEY'S PROCESS OF DRYING FRUITS, VEGETABLES, MEATS, ETC.

Mr. B. R. Hawley, Normal, Ill., described by a diagram on the blackboard his plan for drying fruit, vegetables, hops, tobacco and meats, and for warming and ventilating apartments. Around a small coal stove a system of vertical copper flanges is arranged so that the air passes between the flanges, the outer jacket, and the heater or stove. In this way a current of heated air is sent into the room and passed downward through the material, carrying off the moisture through an aperture opening at the bottom of the chamber into the smoke-stack. Fruit can be dried in from three to six hours, tobacco and hops in from two to five hours, according to the degree of heat. The temperature of the kiln varies from 130 degrees to 175 degrees. These rooms may be made at an expense of from twenty dollars to $100, according to size; and the stove or heater costs about as much as the drying-room. By using this kiln Mr. Hawley has dried fresh meat, and has perfected a method of curing beef in Texas and other warm countries, and, in connection with Mr. F. H. Hatch, of New Orleans, proposed to engage in the business of supplying a good article of cured meat by a complete method, for which they hold letters patent. A committee was appointed by the Club to go to the Metropolitan and test some of the meat prepared in Texas in this way.

Tulare County, California.

Mr. Isaac B. Rumford, Vandalia, Tulare county, Cal.: As I have received many letters of inquiry concerning this country, it may interest some of you to hear how we are making out, and what we think of the country after this dry season. My record of the rainfall gives a total of 10 $\frac{85}{100}$ inches of rain for the entire season, and all that fell in November, December and January. About two inches was wasted, as what it started in the way of grass and grain died before the other rains came. We sowed our grain on fallowed land in the dust, and it sprouting with that November rain was mostly destroyed, though enough came the second time of barley and Sonora wheat to give us a small crop of best quality of hay. I have reason to believe, if we had not sowed until the soil was wet down six inches, we would have done very well, and better still if we had drilled in as we intend to do some this year. I tried a few rows in the garden. In one putting the grains a half inch apart, rows two feet apart, that equals fifteen pounds of seed per acre. The next the seed an inch apart, or seven and a half pounds per acre. The third one and a half inches apart, and the fourth lot seed two inches apart in the row, equal to only three and three-quarters pounds of seed per acre. They all did well, and the last, equal to the first, yielding at the rate of twenty-five bushels of grain, or three tons of hay per acre; thus a good crop, with a great saving of seed, quite an item here this year, when grain is worth three and a half cents per pound. Our best time for plowing here is in the summer after the rains are all over. Thus we can take it at our leisure and have all ready before the rains begin. With a Collins cast-steel plow, our land was turned over ten to twelve inches deep by three very ordinary farm horses, and the sun has cracked it up so that it will be like a garden when the first rain comes. The subsoil plow we put in after the other, fourteen inches deep, to prepare for vines. The result you can have next year. Those planted this year were but little better than cuttings, and did about as well, the poorest dying; but most of them growing from three to twelve inches high. The vines that were planted last year made from five to twenty feet of vine, with fine, well-ripened wood, and have held their leaves through all the hottest weather firm and green. Peach pits, planted in the spring, grew to be two feet high, and have not only held green through all the dry and heat, but are growing these cool evenings, thus demonstrating that they will also succeed here without irrigation. Pear grafts on quince have also been very satisfactory. Most of the vegetables, melons, etc., failed in the hot weather for want of moisture; but tomatoes and melons seem to be finding it again enough to grow. We have arranged to irrigate from the well within a month; and when the water reaches vines, trees or vegetables, they grow as if there was phosphate around them. Without irrigation or manure, this land has produced a much better crop of sugar beets than I ever succeeded in growing of a good year in Pennsylvania with a heavy dressing of manure. We all like the country, even this year, finding it healthy, pleasant and beautiful. There is still plenty of land for preëmption and homestead; but a report has come that the men have begun work on the railroad. It ought to be here in a year. Then the land will be taken up fast.

Adjourned.

October 11, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

TOMATOES.

Mr. H. G. Pollock, Warsaw, Ind.—During the past season I tried the experiment of trimming a few of my tomato plants soon after the fruit began to set. The most of the fruit on plants that were trimmed began to rot before it was fully ripe. While on plants not trimmed all ripened in a sound condition. Among a number of sorts which I have, only three are worth mentioning: Lester's Perfected, good size, smooth, but not solid; a new sort, called here the Grant, I believe to be the Tilden, early, smooth and solid, second only to the Trophy. On eighteeen plants of the latter I had the nicest lot of tomatoes I ever saw; they are early, large, smooth and very solid. And now I would like to ask the Club how near to each other can the different varieties of the tomato grow without mixing?

Mr. A. S. Fuller.—It is hard to say. In one instance they may grow within two or three rods and not mix, and again the pollen may be carried half a mile even. It depends on the winds and on the insects or birds which abound in the locality. There is really no positive security, though, under ordinary conditions, five to twenty rods is sufficient.

Dr. I. P. Trimble.—For ten years past I have grown two or three sorts of little tomatoes, the size of cherries, and in the same garden as the ordinary varieties, and there has been no hybridizing.

The Best State for Stock Farming.

A correspondent writing from Oswego, N. Y., desired information on this point. He can command $5,000, and would locate in a section no colder than Virginia.

Mr. H. L. Reade.—I consider the southern tier of counties in the State of Iowa as among the most inviting at present of any on this continent, for the man who proposes to make money by feeding cattle. I enumerate as advantages: 1. Good quality of food. 2. Plenty of it. 3. Accessible water. 4. Mild and not long winters. 5. Nearness to market. Other sections have some one or more of these advantages, but we believe not as many, and perhaps in no case all. Incidentally, the same section is invaluable for general farming purposes, which will make homes there agreeable when the grazing has been pushed further toward the summits of the Rocky mountain ridge.

The Chairman.—The Indian lands of Kansas lately put upon the market, are, I perceive, very highly spoken of by some authorities, whose judgement is worthy of respect.

Dr. J. V. C. Smith.—I recently made a little journey with a gentleman, who has several stock farms in Iowa, and he says the trouble there is, that you are obliged to feed the cattle during the winter, and the consequent labor and expense serves to greatly reduce the profit. It is especially important for one who would embark in this business to get where the winters are shortest, and, of course, our worthy chairman, who is never far wrong, is especially right when he speaks well of Kansas, though I am not sure there may not be some trouble, at least in a portion of that wonderful State, on the score of the water supply.

Mr. J. D. Butler.—There are thirty-five million acres in Iowa, only six millions of which are yet under tillage. A large portion of the remainder is in the hands of speculators, who are glad to have cattle graze them, provided the owners of the cattle pay the taxes. I think Nebraska is the better in the long run. Droves of buffalo, inmense in numbers, have found sustenance there for many years, and it is reasonable to suppose that where wild stock lives and prospers tame stock would live and prosper.

Dr. J. M. Crowell.—It does not follow. A friend of mine, who knows well whereof he affirms, says he cannot raise cattle to any considerable profit, that is, at distant points, where he has to give much of time or money in providing for the winter's keep. He went, at last, to south-western Tennessee, where he and his family, as Rip Van Winkle would say, are likely to "live long and prosper."

Mr. H. L. Reade.—If there is money in raising and fattening stock in New England, on land which costs sixty-five dollars per acre, and where winter is practically eight months in duration, there certainly ought to be money in the same business in Iowa, where land is procurable at a mere nominal price, and where winter is later in coming, and does not linger so long in the lap of spring. It depends, I suspect, in this as in other matters, more on the man than on the locality. In balancing the relative attractiveness of thousand different places at the west, the soil is not so much to be considered as railroads, county roads, growing towns, the drift of emigration. If called upon to show the ground of preference a great deal might be said to justify the opinion that Mr. Lyman holds. But the question of place is not half so important as those of age, health, hopefulness, vigor, pluck and thrift.

Mr. F. A. Rooker, Mount Joy, Penn.—Some days ago this question was asked, and Mr. Lyman condensed his opinion into one phrase, "fifty miles east or west of Omaha," as the place desired. Now, I don't wish to be understood that I don't think that a good grazing country. But I believe that fifty miles east or west of Leavenworth would be more desirable, on account of a more congenial climate, having shorter winters and longer summers, and consequently a longer grazing season; and, if I mistake not, it is a better corn country than that named by Mr. Lyman. I would like the opinion of the Club whether I am right or wrong; and if I am wrong, please state in what particular.

Mr. E. Nichols, South Creek, Dixon county, Nebraska.—As to the propriety of Mr. Lyman's answer, I will say that I live thirty miles west of Sioux City, twelve miles from Poncah. Poncah contains three stores, two blacksmith shops, one tavern, one saw and grist mill, and two saw-mills in neighborhood. Country rolling, with numerous valleys, generally abounding in large, unfailing springs of pure, sparkling water. Homesteads may be had. Timber is somewhat scarce, but is easily raised, enough, however, for present purposes. I am north of Omaha, on the stream called South Creek on the line of railroad now in course of construction by Mr. Blair, near the Boston colony. Rich pastures of the thousand of acres lie all around us, waiting for a little capital, accompanied by a great deal of bone and muscle.

Plowing in Clover.

Mr. R. N. Kellogg, New Salem, Mass.—I have seen much written about the practicability of fertilizing with clover, but do not remember to have noted special directions. What seed is most suitable, and at what stage of growth should the crop be turned under? The Club must be aware that practical instruction is of very great value, and that its value is measured by the explicitness of directions.

Mr. F. D. Curtis.—My practice has been to sow the common red clover seed, and turn it while in blossom.

Mr. A. S. Fuller.—I regard the big red Dutch as the best clover for this purpose, and would strike in with the plow as soon as the seed is well formed, just before it begins to harden.

Mr. H. L. Reade.—In some localities and on some soil it might be necessary to begin earlier, lest the burden upon the surface be so great as to make troublesome work in turning.

Mr. J. B. Lyman.—Mr. Kellogg, in Salem, Mass., must not be misguided by the brilliant reports of such farmers as George Geddes and John Johnson. On a strong clay soil in western New York they have kept up the fertility of their lands by plowing under clover. But John Johnson now says that he believes he would rather keep more stock and feed out the clover and cart the manure. But Mr. Geddes is quite certain that plowing under a heavy growth is fertilizing at less cost than to convert it into yard manure. First of all, I would advise Mr. K. to get a heavy growth of clover, to cut it in June, and let it grow a month or more, and then pasture it till frost; then turn it and let it lie till spring; then harrow, but not so as to disturb the sod, and plant corn. After corn plow well, harrow thoroughly, and put on grain, with a top-dressing of well-rotted manure. Mr. Geddes says he gets all the good he can out of a field before he makes manure of anything that stock will eat.

Trout Culture.

Mr. B. F. Rosenberry, Alliance, Ohio.—I have a reservoir, scooped out of clay soil, by which, through wooden pipes, I conduct water into my barn-yard for cattle. The pond is stocked with common creek fish. The only water that enters it gathers there from a field during heavy rains and wet weather. The native fish do well. There is an old, abandoned coal slope on the place, that is always full of water that oozes out from the coal. The fish could go several hundred yards under ground, and could come up the slope in the sun. I can turn a little stream into it that runs about two-thirds of the year. Would fish do well in it? Would speckled trout succeed in water of this kind? or would there be too much sulphur from coal in the water? Under the ground, water would always be about one temperature; in summer it would be warm up the slope, where the sun shines upon it.

Dr. J. M. Crowell.—Trout would live in such water, but not thrive. Trout don't prosper on clay bottom; black bass would do better. The latter are tough, and can stand almost anything in the way of rough usage or surroundings which would be uncongenial to fish of more dainty disposition. Speckled trout require a spring or brook of cool water, on a rocky, gravel or sandy bottom. Streams with clay bottoms are not suitable for trout; for such streams, black bass, or some other fish, would be preferable. Trout can be raised with success and profit anywhere between Richmond, Va., and as far north as our territory extends. The best temperature of the water is forty-six to fifty degrees Fahrenheit, but they will do well in streams that rise to eighty degrees, provided they are deep or have some cooler depths to run to. When regularly fed, their growth is very rapid. It is not necessary to provide them with animal food. My experiments, conducted with great care for several years, have demonstrated that curdled milk for young fish, and curds for those of larger growth, is the most economical food, producing a more rapid growth than any known substance. Meat, and the trimmings of meat from the slaughter-houses, are good for them, provided it is fresh; although I do not consider it well to feed them on it, as it encourages their carnivorous propensities. Angle-worms cannot be obtained in quantities sufficient to make them economical. It is also important to successful trout raising to kill off all the old male fish of the species, as they destroy each other at mating and spawning time. Black bass, perch, and many other kinds of fish, are easier and safer to grow than trout. A trout brook of half a mile can be stocked with 500 trout, at an expense of ten dollars. For those living near the sea, I would recommend the cultivation of salmon. They can be kept in fresh water runs and streams until one year old, and then be allowed to go to sea. Three-fourths will return in a year, averaging five pounds each, and if allowed to return again to sea, will come back to the stream or pond where they were spawn, weighing from ten to nineteen pounds each, and at no cost for raising. In the construction of all runs or fish preserves, one-tenth of the length is a good guide for width, and the form should be an elongated oval. A cigar is a good miniature model. Avoid, above all things, spreading a small amount of water over a large area. It is desirable that the water should sweep through the entire breadth of the run.

One inch to six inches in depth for fish one year old, twelve inches to three feet for two year old, and two feet to five feet for the older fish, are good depths for the construction of the runs. If you are at the head of the stream, or have a spring or a brook that is not liable to freshets or be soiled, it will be more economical to dam the brook. Rapidity of growth depends upon the quantity and frequency with which they are fed. The expense of raising trout on curd where there is good natural feeding is twenty cents per pound. The wholesale price in the New York market is ninety cents per pound. It is true that many persons have bought trout-spawn and tried to raise them; but, owing to the tricks and dishonest practices of those engaged in the business, no one has as yet been successful, and I would advise no one to purchase spawn unless the blood vessels are visible. The nearer spawn is to hatching the better it bears transportation, change of temperature, and the greater certainty of each ova producing a live, vigorous fish.

Mr. A. S. Fuller.—And now will Dr. Crowell, whom we must acknowledge to be excellent authority on the subject, please to tell us if anybody has trout to sell. We have heard of fish culture for ten years. There is plenty of trout-spawn advertised, but who sells trout?

Dr. J. M. Crowell.—There are persons on Long Island and elsewhere who get really good incomes from the sale of fish grown in the artificial way. Still, there are many in the spawn business, who find, like Pharaoh's daughter, a little profit in the water, and some resort to trickery. So there are many nurserymen, but, of course, there is no deception in their practices. My advice to purchasers of eggs is, I repeat, don't pay until you see the heart and blood vessels in the ova. The demand for spawn is generally far greater than the supply, hence certain persons who have the facilities rush things. The result is, many are deceived, and the business is discouraged. Therefore, I say, don't pay for ova till you see the heart and blood vessels. And, I add, in conclusion, that, despite the tricks of trade, the time is coming when many half-acres of water will bring as large returns as many hundred acre farms.

Mr. F. D. Curtis.—I would like to inquire of Dr. Crowell, before he takes his seat, what is the proper temperature of water suitable for trout?

The Chairman.—This question has already been answered. Dr. Crowell stated that it is possible to practice pisciculture in different waters, varying thirty-six degrees, but a warm stream must have deep cool holes for the trout to hide in through midsummer.

Mr. J. S. Moulton.—I would like the privilege of asking just one. Can you grow trout in the same stream or pond with other fish?

Dr. J. M. Crowell.—Speckled trout must have the monopoly, and they tolerate no interlopers.

GRAPES FROM NAPLES VALLEY, N. Y.

Mr. Joseph Clarke, Naples Valley, N. Y., sent a fine display of grapes from his vineyard.

Mr. A. S. Fuller.—This cluster is what they call a Black Catawba, and here is the Light Catawba. This fine cluster is the Diana. I don't see any Delawares here, but the clusters of Isabellas are remarkably fine. These grapes are all well ripened, and while they reflect credit on Mr. Clarke as a grape man, we must remember how much he and all who live on those lakes of western New York owe to the remarkable climate caused by these large bodies of fresh water.

Mr. J. B. Lyman.—It is now about ten or twelve years since it became generally known how valuable for fruit most of those situations are which have this peculiar protection. The peculiarity first appears on the eastern shore of Lake Michigan. The west and northwest winds are tempered by the waters of Superior and the upper Michigan, so that peaches ripen 200 miles further north than they do in Wisconsin. Coming east, the same mellow fall climate appears about Sandusky, and along the lake shore, and especially at Kelly's Island, which has been called the paradise of the Catawba. So much has this discovery of its peculiar adaptation to the grape enhanced the value of lands, that farms which were slow sale at $100, now command $1,000 an acre. Though Seneca, Cayuga, Canandaigua, and Crooked lakes are much smaller, they are large enough to produce the desired effect on the grape. The heavy clay lands, as at Geneva, are unsuited to the grape, but in many places the small valleys that run out from the lake are girt by hills made up of shale and loose friable rock, or by drift largely composed of gravel and small water rocks. At such points, which are not numerous, both soil and climate unite to give large vines and ripe fruit. Naples valley, where these clusters grew, is one of those few and highly favored localities. But even here the Catawba is by no means a sure ripener. Last year, for instance, the clusters of truly ripe Catawba from the lake region were few. But we have had a long, hot summer, and thus far a fall remarkably mellow. The result is a splendid crop of ripe Catawbas, Isabellas, and even Delawares. This region will make a great deal of wine this year, probably a third more than any previous year, and California promises to give us 5,000,000 gallons. So it may make but little difference with us whether the vineyards in the north of France are trodden under the heel of the Prussian or not. America is fast learning to make her own wines.

Mr. Bushnell.—These Naples grapes are certainly very fine, but there may be others of finer flavor and better adapted to wine making. The abundance and excellence of grapes in our market this fall are fast giving the business of grape-growing much importance, and thousands who have not been accustomed to growing this most delicious fruit will be persuaded to plant one or more vines. The earliness of the Eumelan, together with its many recommendations both as a wine and table grape, and the healthiness, hardiness, and vigor of the vines are inducements which should be well considered by every one who would plant a single vine or a whole vineyard.

CRANBERRIES AND THEIR CULTURE.

Mr. A. B. Crandell offset this discussion of sweets by a spread of specimens of wild and cultivated berries from the bogs of South Jersey. The gardens represented were those of Mr. Crane, Judge James and Mr. Albert Davis of Tom's river, N. J. Some of the berries were large and beautifully marked or mottled, others were nearly of one color, and deep scarlet all over. The red ones were smaller and more compact. The selected berries from Judge James's bog were a marvel for size, one of them being fully an inch in length. In comparing them with the natural fruit from Judge Crane's premises, the effect of culture was very perceptible. The display attracted a good deal of attention, and the Club insisted on some words of explanation as to the manner in which cranberries are raised.

Mr. J. B. Lyman said, after so much glorification over the grape feast, I am reluctant to take more of our time, especially so as the hour of adjournment is already at hand. The business of raising cranberries is pretty well understood in South Jersey, and thousands of acres there, that a few years ago were so worthless that the more of them a man had the poorer he was counted, have become worth over $1,000. No crop requires such outlay to start it as the cranberry. If any man calculates on getting an acre to full bearing condition at a cost of less than $300 he will generally be mistaken. I know of one bog that is very prosperous, that of Mr. Thomas Ivins, near New Egypt, much of which did not cost him seventy-five dollars an acre. But generally the process is briefly this: A black cedar muck swamp is chosen; the trees and bushes are cut, and the stumps pulled out or cut two or three feet below the surface; all logs, snags, and rotten stuff are dragged away, and then the surface is *scalped; i. e.*, the sod of grass roots and moss is pulled up and carried to the edge of the swamp and piled. The surface is then graded and ditched. The process to this point costs over $100 per acre. Then the black, mucky surface is covered with a layer of white, barren sand to the depth of four inches. Sand is generally very handy in South Jersey. The sanding is seldom done for less than $100 an acre. Then a dam must be thrown across the stream, and carried high enough to put the whole bog under water when required. The plants may be pulled wild from the swamp. They are very hardy and can be transported long distances. The price of cranberry plants for setting out is two dollars a barrel; ten barrels will set an acre. Lines are drawn in squares, the points where they cut being eighteen inches or two feet apart; and a plant is set in the sand, pressing the surface very firmly around it. In three years a good return may be expected. One hundred bushels is a fair average crop, one year with another; 300 per acre is very brilliant, and all figures beyond are prodigious.

HOW CLOVER IS CURED IN GERMANY.

Mr. Charles Yager, Philadelphia, Pa.—A farmer provides in winter a number stakes three or four inches thick and seven to eight feet long, about eighty or 100 to an American acre. In each of the stakes six holes one inch wide are bored in this way: suppose the stake is firmly planted in the ground, the first hole is bored two feet above ground from north to south, the second three inches higher from east to west, not quite half way from the first hole to the top of the stake; hole No. 3 is bored again north and south, three inches higher; hole No. 4, east and west. A little below the top come holes Nos. 5 and 6. Through these holes sticks about five to six feet long are put, so that, seemingly, twelve sticks of about equal length protrude from the stake, crossing each other from right angles. On these sticks the clover is put either right away after mowing, or a little wilted, and there left to dry. This makes a better, more nutritious hay than the best sunshine would, and rains do not much harm, particularly if care is taken to spread the clover well on the two top sticks. The whole fixture is called a "heintzen," and is mostly used on deep clay soils, where the holes for the stakes can be made easily by a peculiar kind of borer. For stony grounds the pyramids are used. Three stakes, six to seven feet long and two to three inches thick, are bored near the top, and then joined there by a wooden or iron bolt, on which they can turn. This pyramid is then put upright on the ground in this shape. Small pegs are fixed in each limb. From one peg to the other on the next limb sticks are laid, and on the sticks come the clover. The number of pyramids wanted for an acre is one-half of the "heintzen," and as old rails will answer for the limbs, the pyramids would probably suit the American farmer best.

Forest Compost.

Mr. Isaac Hicks, N. Hempstead, L. I.—We often hear it recommended to go to the woods and collect leaves and bring them home. On Long Island, we want all the leaves to stay in the woods, around the trees and make them grow. We think too much of our woods to rob them in this way. Wood is valuable, and when we cut it off we want all the twigs and small limbs to stay there and help hold the leaves, and make a fine rich mold to assist the growth of the young trees. The more we cut off our woods, that is as often as once in thirty years, the deeper the mold and the better the next growth if all the small stuff is left on the ground. There is more woods, and better, it is said, in Queens county now, notwithstanding new clearings, than when the country was discovered.. We never thin out the large trees, but wait until ready, and make a clean sweep. Old fogies used to save the trees and cut only the decayed ones. That was a fallacy, and they suffered loss.

Crude Petroleum for Peach and Apple Trees.

Mr. Isaac Hicks, N. Hempstead, L. I.—Painting peach trees and apple trees with crude petroleum will prevent borers laying eggs. Kerosene is a very effectual remedy to drive away and destroy bedbugs, by saturating or placing it where they most love to congregate, the same as corrosive sublimate, and not dangerous either. Kerosene will drive away ants that have a fondness for the sugar barrel, preserves, etc., by putting it near. A merchant in the country rolls an empty kerosene barrel into the place where he keeps his barrel of sugar, and ants decamp.

Adjourned.

October 18, 1870.

Prof. S. D. TILLMAN in the chair; Mr. JOHN W. CHAMBERS, Secretary.

PEAR CULTURE IN CALIFORNIA.

Mr. P. T. Quinn.—The soil and climate of California seem specially adapted to the rapid growth and early productiveness of all fruit-bearing trees. There is no resting time worth speaking of in the vegetable world in California, for the new foliage is nearly developed before the old is cast off. The growing season is much longer than it is at the east, and fruit trees five years in place will average larger than the same kinds under good treatment in any of the eastern States twelve years planted. It is quite common to see pear trees planted only four and five years twelve to fifteen feet high, the bodies measuring from four to five inches in diameter. Upon these young and remarkably vigorous trees are produced some huge specimens of fruit, so much larger than the same variety when grown at the east as to puzzle the best judges to recognize the kind. These very large specimens, many of which found their way to the eastern markets last year, are not the average size of the main crop of the pear orchards of California any more than could the specimens found on an exhibition table of a horticultural society of the east be taken as the average of the crop of fruit from which they were selected. In shipping fruit such long distances, from San Francisco to New York, it would not be wise to send any but the largest and most perfect specimens, until the question could be practically solved whether fruit-growers on the Pacific slope, with so many natural advantages, could ship perishable fruit 3,000 miles over railroad and make it pay. This question is the all-absorbing one now among fruit-growers in California, and there are few men in the east engaged largely in fruit growing but feel interested to know the fact whether California fruits will be shipped east in sufficient quantity to affect the markets and lower the prevailing prices. With fruit-growers on the Pacific slope the subject is all-important. The home markets are overstocked with choice fruits, and consequently prices are lower than the growers can afford to raise them for, and many extensive orchards have not yet come into full bearing.

The horticulturists of California are indebted to the Spanish missionaries not only for the "Mission" grape, but also for other kinds of fruit, among them the introduction of the pear, and its successful culture, long before the gold fever excitement of California broke out in the eastern States. One of the oldest and most noted pear orchards in California is now owned and conducted by the faculty of the Santa Clara College, situated in the San Jose valley, fifty miles from San Francisco. This orchard consists of 600 trees of the leading varieties, including the Duchess d'Angouleme, Bartlett, Dearborn's Seedling, President, Easter, Buerre, Seckle, Winter Nelis, and a number of other choice kinds. The trees are now sixty-five years planted, and appear strong and perfectly healthy, both in wood and foliage. Insects or diseases are almost unknown among fruit in California.

On reaching the grounds our party was met by the gentlemanly president of the college, the Rev. Father Varsi, who extended to us many courtesies while we remained, and accompanied the party through the college building, as well as the fruit garden and orchard. Some of the early varieties of pears were gathered before our visit; but the bulk of the crop was still on the trees. These trees would average from twenty-five to thirty feet high, large bodies, and the foliage without a blemish. Each and every branch seemed to be overburdened; but the extra size and perfect forms of the specimens showed to the contrary, and the gardener assured us the crop this year was not near as heavy as it was last.

Father Varsi told us that from 1849 to 1855 and 1856 the annual receipts from these 600 trees were $20,000, and that with a very brisk demand. Since then the trees have not lost in vigor or productiveness; but are now looking as well as they have at any time within the past twenty years. However, so many have gone into fruit growing since 1855, that now the markets are overstocked; so much so, that the total crop of this orchard was sold last year for the sum of $100.

While examining the orchard, we made a rough estimate of the quantity of fruit then on the trees, and came to the conclusion that there were at least 6,000 bushels of marketable fruit, and these 6,000 bushels could then be bought for $100. Both the gardener and president of the college assured us that it would not pay to have this fruit gathered and sent to San Francisco market. The labor of picking, price of boxes, freight, and commissions, would amount to more than the total receipts from the pears. The faculty of the college had given orders to have 200 of these noble specimens cut down this fall, because there was no demand for the fruit; at least, the prices were so low as to make it no object to continue their culture. This is but one of a number of similar instances we saw, and had repeated to us, of the glut of fruit in California.

At Santa Clara, we were told, on trustworthy authority, that last year fruit was so abundant, and the markets overstocked, that a large share of the crop of pears and apples rotted on the ground. One grower, who could not find a market for all the fruit he raised, went among some of his acquaintances in Santa Clara and San Jose, and offered them all the fruit they needed if they would only come to the orchard and get it. To his surprise, they in every instance declined this generous offer, and stated the reasons were that other fruit-growers in the neighborhood had already volunteered to supply them with all the fruit their families needed, deliver it at their respective residences, and charge them nothing.

At Napa Valley, another fruit-grower, R. B. Woodward, has 100 acres in apples, pears, peaches, apricots, plums, and nectarines, all of them doing well, freed from diseases, and almost so from insects. Mr. W. told me that for five successive years he had kept a ledger account with his bearing orchard, and each year the expenses were more than the receipts. He said: "The last two years I have given up keeping an orchard account, from the fact that I don't want to know the exact amount I lose on my fruit farm each year."

The opening of the Pacific railroad brought temporary gladness, and hopes for an outlet among the eastern markets for the surplus fruit grown in California.

There was a large quantity of pears and grapes shipped from there last year to Chicago, New York and Boston. Last year's experience in sending fruit east was very discouraging, both to the grower and shipper. The returns made did not cover the expenses of freight and commissions, not taking into account the value of the fruit at the orchard, boxes for packing it, etc., etc. A. Lusk & Co., fruit and commission dealers at San Francisco, told me that every man who shipped fruit east from California last year lost money; "but," said they, "we will try it again this year, because we have more fruit than can be consumed in this market."

The difficulty is, that rates of freight on fruit are too high at present to leave much margin for profit to the shippers. The tariff on a freight car of the capacity of ten tons from San Francisco to New York is $970, which, adding the expense of getting the fruit to the cars from the orchard, makes it in round numbers about $100 per ton.

In sending pears, these rates of freight would count up to about three dollars and fifty cents per bushel; to which will have to be added the original cost of the fruit at the orchard, boxes, cartage, beside the risk of the fruit spoiling on the way, and then, deducting commissions, it can be plainly seen that such fruit cannot be sold, leaving any margin for profit, for less than from seven to eight dollars per bushel crate. When such fruit has been sold as low as three and four dollars per bushel, as has been the case the present year, it is very certain some person must lose money in the transaction; and this must continue to be the case until lower rates of freight can be obtained in shipping perishable fruits from California to the eastern markets. Such a reduction of rates as would warrant shippers to send large lots can hardly be hoped for until the completion of another railroad. Until then, eastern fruit-growers have nothing to fear from California fruit; for a man in a favorable locality in New Jersey or New York can well afford to sell his pears in a home market for less per bushel than the freight on the same quantity from San Francisco to New York.

I never before fully appreciated the many superior advantages to be had in being located within easy distance of a market; that 100 or 500 extra baskets of fruit is not felt, and does not create a glut; and I returned from the Pacific slope fully convinced that the man who cannot make money out of the soil in New Jersey or New York cannot succeed further west, for his chances decrease in the ratio of the distance from a good market.

Athough California has many natural advantages in soil, climate, and almost being free from disease and insect enemies in fruit trees, still there is at present that one serious drawback, and that is felt by every fruit grower. At the present time, in California, there is but little demand for orchard products, at paying rates. It appeared almost sinful to see hundreds of bushels of choice apples and pears left lying to rot on the ground and fed to hogs; and that in a country where, twenty years ago, the same kind of fruit were worth from $1.00 to $2.50 per barrel.

How Much Beef from a Bushel?

Mr. C. P. Compton of Ames, Iowa.—Can the Club inform me how much beef a bushel of corn meal will make, fed to two or three-year old steers, well sheltered? Also, its comparative value cooked or uncooked? I have looked for figures on this subject but have not found them. Those who feed cattle don't seem to know. On so important a subject it would seem there ought to be some short treatise.

Mr. H. L. Reade.—With regard to the first question, there are two points that are not indicated in the inquiry. A bushel of corn will make much less beef when fed to a poor animal than it will when fed to one in good condition; and, second, the same quantity will make a larger amount when fed to a breed that take on flesh easily than to one which has less natural tendency in this direction. Much also depends upon the previous habits of the animal, whether it has been accustomed to food made up mainly or wholly of grass, or partly of grass or hay and grain. Taking the average of all these conditions, I think that from four to seven pounds would cover the ordinary range, the former answering to the most unfavorable circumstances, and the latter to the most favorable. As to cooked or uncooked food, I consider, in ordinary cases, that cooking adds one-quarter at least to its value for feeding.

Dr. Isaac P. Trimble.—Among the Quaker farmers the other day, I met those who have grown rich from fat cattle, and they calculate to add 400 on an average in nine months, feeding mostly with grass, however, as they give but about ten dollars worth of grain. As I have observed among farmers, it is good grass that does the work. For instance, George Hickman, near Westchester, has a pasture that will fatten a bullock to an acre and a quarter. Of course he makes money feeding; but it requires nice judgment to pick out animals that naturally take on flesh.

VAN WYCK'S GARDEN CULTIVATOR.

Mr. J. T. Van Wyck, Dutchess county, N. Y.—Showed the model of a garden cultivator, of his own invention, and spoke at length of its advantages, saying, among other things, that it does the work of six men. Incidentally he mentioned that in his locality it is of very special importance to save labor. Labor costs more than land. If he can get from two acres cultivated by horse-power as much as from one acre by hand-power, it would pay him to spread himself over the larger surface. It may be different with Peter Henderson, but everybody is not so lucky as to live on land on which one can afford to pay an annual rental of eighty dollars an acre, and grow rich at that.

Mr. H. L. Reade.—I welcome all labor-saving machines. What farmers most need now is something which will do for them what steam does for the mechanic, or the sewing machine does for women. We have the mowing machine and the horse-rake, both of them wonders in their way, but we have not reached the limit to which inventions in this direction can be carried. It takes, say forty days of labor to raise an acre of certain vegetables. We want some hoeing and weeding machine which a horse can draw and a man guide, that will do it in a quarter of the time, and so on in nearly all departments. The man that invents them will be a public benefactor, will help farmers, whose business has never been remarkably lucrative, taken as a whole, to the competence which they so honestly earn and so richly deserve.

Mr. J. B. Lyman.—In Wethersfield, where grain growing is the leading industry, they have brought the culture to a fine point, and know just how to avoid mistakes. With the old common tools, plow, hoe, and fingers, it took eighty days' work to raise an acre of onions. With the tools now in use it can be done with fifty days' work. The essential difficulty is to get over the two or three hand weedings. Where the land is made as rich as it generally is, and must be for big onions, the weeds, and especially the sprouts of white clover, will come in rapidly, and there is no cure but thumb and finger.

Fruit, Grain and Wool in California.

Mr. Wm. M. Tileson, San Gabriel, Cal.—The inhabitants of this country and their pursuits may be divided into three classes. First, the fruit-growers, who are also the wine-makers; the farmers proper, who devote their time to the raising of grain and making of hay, and lastly, the stock-raisers and wool-growers. There can scarcely be anything more attractive to one fond of out-door pursuits and country life than the raising of semi-tropical fruits in a climate like this; and the only way we can account for there not being millions of orange trees now bearing in this country is from the fact that the nervous, restless disposition of the bulk of our people prevent them from being willing to wait the required time for a tree to bear. From the seed, ten years are required to bring an orange tree in to full bearing; the lemon requires seven; and the lime, which promises to be the most profitable of all, but five years. In the nurseries, however, trees can always be bought up to three years old, at prices varying from twenty-five cents to one dollar each. The orange is looked upon as the hardiest tree we have, and really the amount of rough usage it will stand is surprising. I have transplanted upward of fifty of these trees ranging from ten to fifteen years old, and measured eight and ten inches in diameter, from the city of Los Angelos to the mission of San Gabriel, a distance of nine miles, and scarcely lost a tree. The success was accomplished by careful and close pruning, constant cultivation and abundance of water. The labor was done by Chinamen, who for such work cannot be excelled. The trees, although it is not yet two years since they were set out, scarcely show signs of having been moved, and some are now loaded with fruit. When it is remembered that the yearly profit from an orange tree averages twenty-five dollars, it will readily be seen that a man with a few thousand in bearing would have a very snug little income. All of our fruit-growers are rich, which is the best commentary on the subject that can be offered. The longevity of the orange is also remarkable. There are trees in the mission orchard at San Gabriel nearly seventy years old, and still in full bearing. The crop is gathered in January and February, but it is not uncommon to see trees with fruit in every stage, from the blossom to the ripe orange, and the latter, if allowed to remain, will not fall from the tree until the following season, always increasing in sweetness and bulk.

There is no market for grain if raised in any quantity, and, therefore, until transportation is cheaper it won't pay to raise it. For instance, last season there were a few hundred acres more than usual planted; the seed cost $2.50 a hundred. When the crop was gathered it could not be sold for sixty-two and a half cents a hundred! Bags cost fifteen cents each; thrashing, twelve and a half cents a hundred; labor from thirty to sixty dollars per month. Consequently the poor farmer who has been running in debt all winter to the storekeepers, or borrowing money at two per cent a month, is "sold up." There will be better times for the farmer, however, when we have better and cheaper communication with the rest of the world. Los Angelos is supplied with cabbages and potatoes from San Francisco, 400 miles distant, not because they cannot be grown here, but because no proud descendant of a Castilian would stoop to cabbage-raising while aguadiente is to be had by betting on a cock-fight or selling a vote. Hay is made entirely from barley or oats, cut while just in the milk, and harvested in the usual way. No rains ever interfere with the haymaking, and after being stacked loose where it was cut or pressed into bales, it is allowed to remain exposed to the weather with impunity until November. No clover fields are ever seen, and meadow pastures are almost unknown. Before the great drouths of 1862 and 1863, immense herds of half-wild cattle covered the plains between Los Angelos and San Gabriel. The few that had strength enough left for the journey were driven to the mountains; the rest perished, and their bones whitened the plains for miles. Although productive of much suffering, and reducing many from affluence to poverty, it is questionable whether the visitation of Providence did not result in good to the greatest number. The odious fence law is still in force, compelling the poor settler to fence his land against his wealthier neighbor's cattle, or else have his crops trodden down and destroyed without recourse. The cattle have mostly disappeared, but large *manadus*, bands of mares, and *caviadas*, bands of horses, still roam at large over the country.

Sheep raising, although uncertain, is looked upon as a profitable occupation, and is engaged in to a large extent. The wool, however, is poor and "burry," seldom bringing more than ten to twelve cents. To the northward, in the neighborhood of Fort Tejon, the fleeces are free from burr, and command much higher prices. With regard to the advantages offered to emigrants, I would say that the price of labor is never less than thirty dollars per month, with board, and good men who are scarce, can command more. To others, who have means, and from ill-health or other causes are seeking new homes, those who have patience, perseverance and energy, are certain of success. But they will find rough men, and many discouragements, with no sympathy. But as the influx of population increases, all this is changing. Men no longer build themselves huts and cabins, but homes, and bring their wives and families with them. Los Angelos ranks as third city in size in the State, and is rapidly growing. Good land can be bought for ten dollars an acre, but everything depends on the water. Our own valley of San Gabriel is the loveliest the sun shines in. Looking up through the rich green foliage of the orange trees, past clusters of yellow fruit, we see the mountains, their summits covered with snow, towering 5,000 feet above us. From the old church comes the tinkling of bells which for near a century have called the faithful to their prayers; from the west the cool sea-breeze comes through a gap in the foot hills; while at the east, full sixty miles distant, old Mount San Bernardino, with frosted head, stands like a giant sentinel guarding the entrance to the valley.

The Quince Curculio.

Dr. Isaac P. Trimble.—I have here some specimens of a fruit enemy not yet much known. In the absence of a better name it has been called the "Quince Curculio," from the circumstance that the quince is the favorite fruit in which the female deposits her eggs, just as the plum is the favorite of the other species. But this enemy, like the other, does not confine itself exclusively to the quince, but also attacks many of the later pears—the Lawrence, especially. Here are specimens of both quinces and pears showing the effects. Cut into them and caverns can be found, more or less extensive, depending upon the age and size of the grub. These caverns are dark colored, and contain more or less brown dust, partly the castings of these miners. Here are a large number of these grubs. Yesterday 500 or 600 were taken from the bottoms of two barrels of quinces, although those quinces had only been gathered four days before. A friend of mine has a quince orchard of 286 trees. These trees this season would average seventy or eighty quinces to a tree, making more than 20,000. Upon a most careful search I was unable to find one specimen perfect, or clear of one or more blemishes caused by the punctures of this insect. Frequently four, five or six grubs will be found in a single quince. Mr. Goldsmith, the owner, keeps this orchard in first-rate order; he has faithfully kept out the borers, so fatal to the quince trees; has fertilized very freely, and the cultivation is perfect. He told me yesterday that his crop this year is thirty barrels, which will yield him about $125. Had this insect let him alone he should have had at least 100 barrels, worth from $800 to $1,000. Many of his later pears, including the Seckel and Lawrence, have suffered greatly, though not to the same extent as his quinces. A few days ago he emptied a barrel of cullings, chiefly Lawrence pears, and in and near the bottom of that barrel were found at least 400 of these grubs. A month ago I visited the orchards attached to one of the best nurseries in Pennsylvania. I found the sad evidence of the presence of this insect enemy—even the Seckel pears, though very abundant, were almost worthless; later varieties still worse.

Mr. Fuller tells me that he has seen this season, in western New York, the same condition of fruit at a well-known nursery, even the Dutchess pears almost totally destroyed. This fruit enemy seems yet confined to localities, but is spreading rapidly. Twenty years ago I noticed a single specimen puncturing a pear, but for several years the depredations were hardly perceptible. This year 1,700 were caught in one day by jarring 200 quince trees, and I have often brought down more than twenty from a single tree at one time. This curculio, like all others of the family, is a beetle. It is slightly larger than the plum-weevil, and differently marked. The puncture made in the fruit is like that of a pin; there is no crescent. The young grub burrows a little under the skin of the fruit, not working to the centre as the plum-weevil or apple-worm does. The grub at maturity leaves the fruit by boring through, leaving a small gimlet-hole, just as the plum-weevil, or grub, in a chestnut does, and then goes into the earth two, three, or four inches, just as they do. The grub of the plum-weevil undergoes its transformation into a beetle in three or four weeks, and then lives as a beetle through the fall and winter, and in the coming spring is ready for the young fruit. This grub, like those from nuts, remains in its larvæ condition underground not only all winter, but till midsummer of the next year, and then becomes a beetle ready to deposit eggs, and having the instinct to teach it to use as a nidus only those fruits that will mature late enough for the grub to come to maturity. The management of this enemy must be the same as that of its kindred. Destroy the fruits containing the grubs if possible, but if it comes upon the trees the next year, *jar it down on canvas and kill.* My friend Goldsmith does not intend to lose $700 or $800 worth of quinces another year from this cause. He intends to *jar.*

BONES AND BONE-GRINDING.

Mr. Thomas Johnson, Pleasantville, Penn.—Will the Club please to give information on manufacturing bone flour and bone meal; where bones can be had in large quantities, what kind of machinery to use, and where to get it?

Mr. J. B. Lyman.—In cities, 20,000 persons are good, on an average, for a ton of raw bones a day. I presume Newark gleans the bones as clean as any town, for they have a very large bone mill two miles out, where cash is given for every load; and with a population of 120,000 she sends to the mill six tons a day. This includes heads and heels from the butchers as well as domestic bones. It is very much easier to make bone meal than bone flour. Bone is crushed by iron teeth or prongs revolving slowly against other prongs that are fixed after the fashion of a bark mill; then running through finer teeth makes the fragments less, but flour is not the result. Two broad wheels, faced with ridged steel of the hardest sort, revolve in opposite directions, and the stream of bone meal is poured on the point where they touch or nearly touch. The particles are caught and rasped or grated into flour. If you put raw bone between flat stones revolving after the manner of flour mills, the grease and glue will fill the cuts and the faces will slip, and you might as well try to grind hard soap. As for bones in quantity he can get them in the cities, but they will cost him from twenty-five dollars to thirty dollars a ton. The best plan for him in Pleasantville is to contract with butchers and farmers and hotel-keepers, and collect a moderate quantity of raw bones and erect a tank for boiling them for grease. Then he should sort them, and he can sell the clean firm shins of oxen and cows for eighty dollars. They go to brush and button makers. His thin bones he can crush to bone meal, or coarse bone, in a mill that does not cost more than a common bark mill. These can be rotted quite fine by using sulphuric acid and water. He need not be above taking dead animals to the pit and reducing them, bones and all, to manure with acid. In that way the grease and the choice bones will about pay the cost of the mixed bones as he buys them, and the manure will not cost him much over the price of the acid and the labor of the boiling and grinding. Bone mills of this sort ought to stand at intervals of from ten to fifteen miles on the main roads of thickly settled communities. Before he goes into it, he had better visit the great establishment of Lister Brothers, near Newark, where thirty to fifty tons are handled in a day. The bones that are ground and used in this country are those made by the three or four millions that live in great cities. Those made by the rural and town populations, 35,000,000, are lost to the soil. We waste or neglect over 300,000 tons, annuully, of as good manure as can be used, yet our average of wheat per acre is not much over ten bushels.

A DOMESTIC FRUIT DRYER.

The Rev. Mr. Miller showed a model of a fruit dryer, made by lining the inside of a box, like a dry goods package, with tin, and making on the sides little flanges or supports for wire shelves. The box should be of a size to fit over a common cooking stove. He calculates that we need a fire for cooking only six hours in a day, and often much less. Then for twelve hours or more the fire may be kept low, and this dryer full of apples or peaches, is set on the stove. There are holes at the top for letting off the air laden with moisture.

Mr. H. L. Reade.—I approve of this simple contrivance, it seems to me just what our farmers want.

Mr. J. B. Lyman.—Now there are before the public three methods of drying fruit with artificial heat, each cheaper than the other and operating on a different scale. First, we have Mr. Charles Alden with his large chamber, big enough to take in thirty bushels on sieves, and heated by a blast from a steam-coil to 170 degrees. He can thus dispose of 100 bushels a day, and make ninety cents a bushel. B. H. Hawley of Norman, Ill., creates a current of hot air by flanges or straps of copper around a stove and inside a jacket that fits over them and the stove. This blast he takes in at the top of his drying chamber, and lets out the air made cool and moist by contact with the fruit through a hole near the bottom of his chamber. At a cost from fifty dollars to $100 he can be prepared to handle thirty bushels a day. This simple contrivance for the top of a stove will suit families; when actively used it can dry five bushels a day and perhaps more.

WATER PIPES.

Mr. C. V. Price, Wayne, N. Y.—I wish to be informed by some of the experienced members of your valuable Club in regard to the best and most durable mode of conveying water from a spring to my yard, a distance of sixty rods, with about twenty-five feet fall, and also the cost of the pipe or conductor. Please accept my thanks for the very valuable and useful information that you are spreading broadcast throughout the land.

The Chairman.—If there is anywhere near him a pump-log borer, my advice is, that he get sixty straight logs, about a rod each in length, if the auger is that long, and have them bored. If he can't get at it this fall, it will be good winter work. When the supply is regular and large, and the logs are well driven together, and buried over three feet, they do the work better than cement or lead, and are cheaper. There is always a risk in using a metal that corrodes; and cement means lime, and that may make the water hard at first.

POULTRY FOR PROFIT.

Mr. Henry F. Hughes, of Newburgh.—I want to keep and raise poultry for profit. What kid of fowls should I get, and how should I treat them as to feed? Will hens that are kept shut up lay well, if fed well? Can they be fed and kept so as to insure their laying through the winter? Can you not give me a few practical directions?

Mr. J. B. Lyman.—Before a man wades deep into the chicken business my advice is, that he considers how cheap he can feed them. A hen is a machine for turning good victuals into the best of all food, a new-laid egg. A chicken is a machine for turning such aliment as grain into poultry meat. If eggs are to be his special object, he must have food that contains a good deal of gluten or albumen; that is, food that is rich. A hen can't make eggs on boiled potatoes alone. Corn, especially when fed as pudding, will probably make chicken meat as fast and as cheap as any other feed; but corn alone is not enough to set hens laying fast. They must have meat or wheat, or both. Upon inquiry, I find every man who makes anything worth talking about in eggs is a profuse feeder. For instance, a neighbor of mine averages 200 eggs a week all summer for 100 hens. He feeds wheat and corn liberally. Warren Leland makes a pound of flesh a month on each chicken, and has 500 turkeys to sell this fall. His brother Simeon has about as big a flock of turkeys. They bring up from their hotel two barrels, every other day, of broken meat and bread for their poultry yards. I would advise him to delay his chicken venture until February, and then make ready for 100 hens. For that many he needs at least an acre of range. Let him keep figures during the summer, feed high, and compare the cost of food with the value of eggs and meat. As cold weather comes on he should fit a house in a side-hill, so as to give a warm, sheltered place, with tight wall on the north and windows south, so the hens may have a place to lay in, where the eggs won't freeze. Continue to feed high, on refuse from the hotels, or on wheat and corn, and in a year see what you have made with 100 hens. Then you can go in deeper, and keep 200, always adding to the range an acre to each additional hundred. The men are few and expert who make much on flocks of over a hundred, yet many thousands *can* be kept on one place. But when he has taken lessons on his first hundred, and would venture higher, let him ride up to Rye Station, twenty-five miles north of New York, and visit the farm of Mr. Warren Leland.

Adjourned.

October 25, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

SMUTTY WHEAT.

Mr. Charles B. Porter, of The Contra Costa Gazette, California, cannot understand why the "blue-stone preparation," alluded to at a previous session of the Club, should not be found an infallible preventive of smut in wheat throughout the Atlantic States. Since its first application in his vicinity, fifteen or sixteen years ago, no crop from properly blue-stoned seed has been damaged with smut, and this is the universal experience in his State. Before this soak was used there few crops of wheat were raised without more or less damage from this disease. It is now a very rare thing to hear of a smutty crop; and never when the seed has had the blue-stone treatment, which only the most careless farmers fail to apply.

Mr. Watson Newbold.—As far back as forty or fifty years ago smut prevailed to a great extent throughout Burlington county, N. J., and my father adopted the plan of soaking selected seed wheat in brine, and then dusting it with air-slacked lime. This proved then, and has proved ever since, a perfect preventive, without a solitary exception.

Miss Morgan.—My father in Ireland was long accustomed to the same practice, and with the same results.

Mr. Vangulick.—I have found the plan equally valuable in oat culture.

REPORT OF THE COMMITTEE ON THE TRACTION ENGINE FOR PLOWING.

Mr. J. B. Lyman, chairman of the committee to investigate the claims of a traction engine, as a power to draw a gang of plows, read the following: Your committee remark that on Wednesday last we went with D. D. Williamson to Patterson, N. J., and saw the working of Thompson's road steamer, both as a traction engine and as an agricultural force to draw a system of plows, and we report as follows: Ever since George Stephenson gave to modern civilization the locomotive on iron tram-ways, a succession of acute and able engineers have been devising a steamer on wheels to ply on common roads and over plains without roads, to haul heavy wagons, handle crops, and draw a gang of plows. The difficulties have been found to lie in the nature of things, and until a recent date they have been insurmountable. Thus, if a common smooth-tire wheel was used, and the parts made light the friction of the wheel on the earth was not enough to prevent the wheel from slipping on a hill. If weight was added, the consumption of fuel was much greater, the cost higher, and the damage to the road-bed serious. If the wheels were made with ridges or flanges to bite the ground like the wheels of a mowing machine, great loads could be drawn, but they tore the road bad. If the steamer and its wheels were made heavy and solid, the jar, in going over any roads but the most perfect, would soon wear the parts and render them useless. It was reserved for Mr. Thompson, an engineer in Edinburgh, to apply gutta-percha as a wheel-tire with such skill and judgment as to overcome most of the difficulties named, and he has given his country, and now offers to America, a road steamer or traction engine of great prower, easily managed, compact and durable, doing the work of fourteen horses, consuming but 100 pounds of coal an hour, and sold at $5,000. We found the engine at the race track near Paterson, hiched to a gang of seven plows, and breaking a tough old sod. It consist of a steel boiler hung between two driving-wheels, with a small driving-wheel in fromt, over which the engineer sits. The cylinders, six by ten inches, as also the cog-work connecting the pistons with the wheels, are concealed behind the wheels and below the boiler. The striking feature of the engine is the rubber tires; these are six inches thick, and are not riveted to the wheel, but are made a little smaller, and by stretching before going on, the contraction holds them tight. They are made of gutta-percha, combined with antimony. The rubber tires are capped or protected from the wear of the road by a steel chain or reticulation so hinged as to yield when the tire yields, and come out when the release of pressure brings the rubber out to a perfect circle. Now for the operation of these remarkable and ingenious wheels. The engine weighs six tons. When running without a load there is a pressure of three tons on each wheel at the point of contact with the earth. This weight flattens out the rubber. So instead of a line of contact an inch in width, as with the iron rim, the pressing surface is nearly a foot. When a load is attached the backward strain compresses the rubber still more, giving a larger and larger friction surface. In this way the grand problem in traction engines is mastered; the power of the engine is exhausted before the wheels slip on an average firm surface. This elasticity of the wheel enables it to pass over soft places with but little sinking, and it relieves the jolt from stones. Soon after we reached the field the engineer turned his starting bar and we saw the amazing and hope-inspiring spectacle of an iron horse moving steadily over the sward and dragging seven plows that turned seven as even regular furrows as fourteen of the best plow horses in the Empire State could turn. The performance we saw shows, as we think, this important truth, that we have offered to American farmers a motive power that can pull as hard as fourteen horses, and on a uniform surface can so continue for a day to move and to plow seven furrows a foot wide and eight inches deep. The cost of this work will be the wages of two men, the price of half a ton of coal, and the interest on $5,000. But for farm service we think the boiler and ash-pan beneath must be raised a foot higher than in the engine we saw at its work. It must also be said that if when drawing a load both wheels fall suddenly upon sand so loose as to give no fulcrum, the steamer will be likely to stall. But we think we see in this road steamer the beginning of the long sought for marriage of steam locomotion to agricultural work, and as such we ask the progressive men of this country to examine it, to see it work, and after experience has wrought certain changes, set it to turning the prairie sod of our boundless west and to pulverizing the cotton and cane soils of the south. We would suggest to Mr. Williamson and his friend the inventor, in Edinburgh, that as a traction engine for use about foundries, lumber yards, quarries, mines and factories, we see no changes required. The steamer they offer can release thousands and thousands of our most able horses and permit them to apply their strength to the furrows, from which our bread may grow. Each engine made will release fourteen horses from tumbrils, timber wheels and freight wagons. But our farmer needs some important changes made in this engine before it will suit him. Let Mr. Williamson show us a steamer of about six-horse power, capable of dragging three plows in sod and five in light stubble; the rubber band may be thinner, the gearing more simple, and the cost not over $2,500. Such a machine could plow, haul manure, ditch, thrash, make roads, haul lumber and stone, lift water for irrigation, saw wood, dig cellars, grind meal and gin cotton. Yet its cost would not place it beyond the purse of every prosperous and enterprising cultivator of 200 acres, and each neighborhood would support at least one such invaluable and tireless laborer. We recommend this machine, or such modification of it as we have partly described, to the attention and fostering interest of American farmers and engineers; for we believe that in this direction lies the strength of the tillage that is to be, and the chief material victory that is to make the next generation more affluent in resources and richer in all the means by which the kingdom of nature shall be made tributary to the kingdom of the intellect.

J. B. LYMAN,
H. L. READE,
ISAAC P. TRIMBLE,
Committee.

Prof. Jas. A. Whitney.—Having witnessed the operation of the Thompson Road Steamer, I feel compelled to differ decidedly with the committee on many points of their report. For drawing loads on common highways the machine worked well and was handled very easily; it will undoubtedly serve an excellent purpose in many mining localities, quarries and ship-yards for tractive uses, where it is inconvenient to lay down rails; but I do not believe that this or any other traction engine, traveling over the ground and drawing a gang of plows behind it, will ever work to the profit or satisfaction of the farmer. The apparatus in question passed but once around a field containing two acres or thereabout, and in so doing sunk in a soft spot with the ash-pit on the ground, and some twenty minutes were required to dig it out with shovels. It is said that the ash-pit may be raised, and that those now building will be so altered, but this will disturb the equilibrium of the boiler and will probably interfere with the economical action of the engine. The rubber tires undoubtedly give a greater holding power to the wheels, but this is obtained at the expense of a loss of power at least equal to that required for the continuous compression of the rubber.

Mr. H. L. Reade.—The place that Professor Whitney mentioned into which the machine sank, was a hollow several feet deep, but recently filled with sand to make it up to the common level of the other portions of the field. With the exception of the dissenting member, none of the committee considered the occurrence as militating against the value or desirableness of the machine for the purposes of plowing.

CIDER VINEGAR.

Mr. W. H. Bishop, Toledo, O.—Will vinegar made in open tanks be as good as that made in barrels? Will hastening the process by exposure to air and heat detract from the quantity or color? Is it not customary to dilute with rain-water, and in what proportion? Is heat as efficacious as air in hastening fermentation? I am thinking of having made a small galvanized iron tank, to be placed near the kitchen stove, for the purpose of keeping a portion of my cider undergoing the acetic fermentation during cold weather. Would the acid render the vinegar poisonous by its action upon the iron?

Mr. John Daws, Imlaystown, N. J.—I am aware that what I answer will be examined by a vast number of persons who read the Club reports, and for that reason I will be explicit. The apple in its natural, and also in its cultivated state, from which cider is made, contains, among other things, the germs of alcoholic and acetic fermentations. Cider, when first pressed from the pulp of the apple, contains, among other things, acetic acid and sugar or saccharine matter. Immediately after being reduced to pulp by the process of mashing or grating, as is the practice in cider-making, if exposed to the air and a certain amount of heat, the alcoholic or vinous fermentation commences. Simultaneous with this commences the acetic fermentation, the result of which is vinegar, and this is rapid or slow according to certain conditions of air and heat and light. No cider or alcoholic liquid will turn to vinegar without the presence of oxygen. It is the union of oxygen with the alcohol in the cider that forms cider-vinegar. To effect this is the art of vinegar-making, as I understand it, to accomplish which different practices are used. I state mine only, as it includes the whole process from the planting of the trees on which the apples grow, down to vinegar-making. I aim in my selection of the fruit to grow those which in my opinion have the most acetic acid inherent in them, and those that have the greatest amount of saccharine matter. I aim to gather them when fully ripe, keep them clean, grate very fine, and press the cider out without the addition of any water. Put the cider in perfectly clean, well-bound white oak casks or barrels, fill full to the bung, let them remain in the open air until after the alcoholic fermentation is completed; then rack off all the clear liquid, being careful not to allow any of the pomace to run out with the pure cider; then empty out the silling and wash out the casks, and put the cider back to ripen; remove the casks to a dry, warm, airy place; let them remain a few days, then procure another cask as before stated, made of the same material, clean and well bound, and place it beside the full one, and commence by drawing out daily one gallon from a faucet in the head, and let it fall as far through the air as can conveniently be done into a wooden vessel, and pour from as high an elevation as can conveniently be done into the other barrel; continue this process daily until all the pure, clear cider is drawn out. Cleanse as before, if necessary, and commence putting back in the first cask, and this alternately until vinegar is attained. Any one at all familiar with the nature of cider knows from experience, that when we draw out first from a full barrel in warm weather the cider is much sweeter and better to drink as a beverage than after the barrel has been drawn from for some length of time, the drawing out by admitting fresh air simply accelerates the acetic fermentation. My object in drawing daily a small amount, and putting it into another barrel, is to introduce it more effectually to fresh air, and at the same time prevent too much exposure, whereby the alcohol would escape at the same time. If I wish to convert a small quantity of fermented cider into vinegar immediately, I take a vinegar cask, and put ten gallons of good vinegar and a quart of *mother*, and place it in a warm place, and put in a small quantity of cider daily, according to its acidity and its tendency to that condition. In this way I have never failed in making and having on hand a good supply of first quality cider vinegar. It is an old maxim "that it takes money to make money." This maxim is truer of vinegar than of money. Air, warmth, and light are indispensably necessary to make good vinegar; a well ventilated, dry, and warm apartment should not be overlooked; too much exposure to the open air impairs its quality and quantity. The degrees of heat necessary is from sixty to 100; vinegar should not be allowed to come in contact with iron in any shape.

THE CRANBERRY CROP.

Judge Morris K. Crane, of Toms River, N. J., having sent the Chairman a half bushel remarkably large cranberries, grown on the land of Judge James of the former place, the Chairman called upon Dr. Bristol to give an account of the cranberry crop in New Jersey.

Dr. Bristol.—So much has been written and printed of late touching cranberries and their culture, that any further remarks could only be regarded as an unjustifiable repetition. But I will say that the bog upon which these beautiful specimens grew has produced this season the largest crop of any of its size in the entire State, and that this fact seems to afford proof that other lands than cedar bottoms are well suited to this excellent fruit. Judge James's bog was formerly a gum and maple swamp. I have been asked frequently as to the probable aggregate yield in Ocean county. Statistics have not been collected yet, but 25,000 bushels would probably be a low enough estimate. The crop is smaller per acre than last season, but it is thought that the new bogs which have come into bearing this year will more than make up the deficiency. The price now is $3.25 per bushel, but many growers are waiting for an advance, and there is reason to suppose that their greater expectations may be at least partially realized. The fact that they can hold the crop for weeks, and even months, is a great argument in favor of the further cultivation of cranberries. There are other arguments carrying weight in the same direction, and carrying such weight that city men and capitalists everywhere are coming in and possessing the suitable lands of South Jersey, only comparatively a very small portion of which have as yet been appropriated. There is no danger of overdoing the business, at least not for many years, if ever. Cranberries are now worth three times as much as they were when the product of natural bogs was all that found its way to market. John Webb, the pioneer in the business, will tell you that he used to find trouble in disposing of his ten or fifteen bushels at one dollar each. Now he finds ready sale at three dollars, and sometimes four dollars per bushel for a crop that frequently runs to thousands of crates.

EARTH CLOSETS.

Prof. James A. Whitney read the following paper:

In cities a flush of water makes the utter removal of vile matters practicable. In the country this cannot be done in one case out of twenty. To remedy bad odors, therefore, recourse must be had to other means. These should refer, not to the immediate removal of the deposits, but to the prevention of noxious exhalations. One method of doing this is to use plaster. This will save much ammonia which escapes during fermentation, but will not prevent noisome emanations, and is somewhat expensive. A solution of copperas may be applied, which will destroy the foul vapors, but the substance itself is hurtful to plants and will poison the manure. Dry charcoal is an excellent deodorizer, but it is only in a few locations that it can be had sufficiently cheap. Chloride of lime may be made useful, but it will decompose the ammonia as fast as formed.

It will be seen that there is some decided objection to each of these methods. Something different from any of them is demanded. Some cheap, simple, and efficient means of wholly saving both the solid and the liquid manure, and of preventing bad gases from contaminating the air. The need of obtaining some such agent is evident from a consideration of the nature of the gaseous products evolved by the decomposition of night-soil. The greater part of the gases is light carbureted hydrogen, which may be considered comparatively harmless, but the reverse is true of the other or smaller portion. This is made up in part of sulphureted hydrogen, the same that gives the characteristic odor to rotten eggs, and which has a specific action on the blood, turning it black. This gas, when inhaled in minute quantities, lowers the tone of the system, and weakens it for the attacks of disease. Far worse than this, however, is a peculiar vapor which not only has the same general effect, but is frequently the direct cause of putrid and deadly fevers.

Night-soil, solid and liquid, contains simply the elements of plant nutrition, drawn originally from the earth and brought by their passage through organic processes into a concentrated form and very soluble condition. For careful computations of its per centage of ammonia, phosphoric acid etc., are needed here, although they would afford the strongest evidence of its value. Practically the estimated ratio between the worth of food consumed and manure yielded by grain-fed farm animals is near enough for our purpose. This places the value of manure at one-third that of the food. The rule will apply as well to the manure, of the cess pool as to that of the barnyard; the richer the food the richer the manure, and the average food of man is richer than that of any other created being.

Dry earth is claimed to fulfill all the conditions requisite in preventing the evolution of foul gases from the contents of privies, and of retaining all the elements of fertility. The so-called "earth-closet" was proposed about a dozen years ago by a Mr. Moule in England, and, during the past two years, has excited much attention in this country. Abroad, very diverse opinions as to its utility have been expressed. Mr. Moule claims that only a small quantity of earth is required to deodorize a large amount of excreta. At one of the meetings of the Dorchester Farmer's Club, he exhibited half a bushel of dry earth, stated to be capable of receiving 160 uses. It is also said that the earth may be used over and over again a half dozen times, by simply redrying. On the other hand, Cuthbert W. Johnson, a good authority, says that in Wakefield prison, where earth-closets, made with removable pans, have given their best results, they can be only partially used. The same writer states that in the village of Halton, where the system has been methodically tried, sixty pounds of earth dried by a coke fire are allowed to every forty uses. In this latter case the receptacles, instead of being removable and cleaned daily, are large enough to hold the accumulations of three or four months, and are made water-tight, to retain the liquids as well as the solids. He also affirms of the earth closet, that "when introduced for the use of cottagers accustomed to the old privy seat and stool, and requiring special service which the average man or woman will not give, it soon becomes filthy and offensive.

After balancing the advantages and disadvantages of the system, it must be apparent that earth, when made dry without artificial heat, is, considering its cheapness, the best to mingle with night-soil. It should, also, be used in such a way that the deposits may accumulate for several months, so as to be available at the season when such manures can be applied with the best results. This can be best secured by some modification of the common privy. The dry earth, furthermore, must be sufficient in quality and quantity to absorb all the liquids, prevent foul emanations, and bring the mass to a moderately dry and friable condition. These functions all depend upon the relative absorbent power of the earth, and this varies much in different kinds.

Many years ago, Schubler determined this power in different earths. He found that 100 pounds by weight of common silicious sand absorbed twenty-five parts of water, but, when heated to sixty-six degrees for four hours, evaporated nearly nine-tenths of it. Sand has, indeed, less power of absorption than any other soil, and the power always diminishes in proportion to the amount of sand. Clay, when pure and dry, absorbs seventy per cent of water, and yields up considerably less than one-third under the test referred to. Still better than clay is *humus*, or decaying vegetable matter, well represented by fine, black, well-decomposed muck. This absorbs 90 per cent of water, of which it gives off only one-fifth when heated as above mentioned. A rich dark garden soil showed very excellent results—

ninety-six per cent of water absorbed, and only one-fourth thrown off by the test.

If the earth-closet system were used as generally as the cooking-stove, the gain to our tillage would be incalculable. Each family of ten persons would keep five acres of average land up to a producing power of twenty-five bushels in wheat or fifty in corn.

November 1, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

The Eumelan Grape.

Mr. M. A. Stephenson, Clyde, Ohio, forwarded a statement in substance as follows: For the past three years I have had a Eumelan vine under my care, and I find it a rampant grower, perfectly healthy in wood and foliage, hardy, and short-jointed. It produces early large crops of black bunches, covered with the most beautiful blue bloom. It grows like the Concord; but, unlike the Concord, does not crack its berries, nor do the berries drop from the bunch, but will hang on as long as grapes dare hang. They are not predisposed to decay, but will dry into most excellent raisins.

New Cattle Car.

Miss Middy Morgan read the following paper: In the course of last March, Mr. J. W. Street, of Iowa, had the honor to speak on this subject. In his able address he laid before you a description of many of the sufferings of the cattle incident to the present system of transit, as carried on throughout this vast country; and he concluded his address with the expression of the hope that ere long a Christian people will view in the light of the past the tortures and sufferings now inflicted on dumb brutes. Mr. Street, anxious to show himself, not only a man of humane principles, but also a practical reformer and sound business man, has gone to work and constructed a car on new and improved principles for the railroad transit of horses and of horned cattle. On the old principle, the animals were jostled into the cars just as chance might direct. The strong trample the weak; the vicious tyrannize over the gentle. To save expense, the cars were loaded to repletion. To save time, the animals were belabored and goaded and driven on with reckless speed until they were on the cars; then all hurry ended, and the unfortunate brutes therein imprisoned were dragged along at the rate of a snail's gallop (pardon the Hibernicism).

They were kept for hours upon hours without food or rest, and, worse still, without water. This latter want frequently drove the animals to frenzy, and I have been told by an eye-witness that at some of the railroad stations outside of this city men were employed to shoot down the mad steers, as they were too dangerous to be permitted to enter the large cattle-yards. Nevertheless, in spite of this precaution, I have myself seen, during the past heated term, many—yes, many—crazed steers. Now, Mr. Street claims that his patent car, in that it is subdivided into separate stalls, prevents the animals being unduly crowded, and also saves them from injuring one another; also, that it is fitted with water-tanks and water-troughs, communicating one with the other; and again, being supplied with grain-bins and mangers, the cattle need not suffer from hunger or thirst; and still further, that, owing to all these improvements, the cattle can be conveyed in less time than by the old system, and that they will reach their destination in better order and in better flesh. Under the old system of transit, the loss to dealers from shrinkage is severe. It is so heavy an item as to amount to a necessary calculation in the purchasing of live stock. Therefore, it must be clear to all that the car and system that saves or does away with shrinkage, is a vast improvement on the system that causes it. I have closely inspected Mr. Street's patent improved palace car, for the transit on railroads of horned cattle, and, in my humble opinion, it is a decided improvement on the older and ordinary car used for the same purposes. But long experience in the transit of horses, both by sea and land, on steamers and railways, teaches me that the car needs two further improvements. In Mr. Street's car the animals enter by only two doors, and in unloading must follow one another out in single file. This occupies too much time, and besides is inconvenient, in that No. 1 cannot be removed until all his neighbors are out of his way. Again the traverses are of bare oak, and offer too much resistance. They are liable to bruise the animals when the car jolts or sways, as of necessity it must to some degree, even though it is hung on passenger-car springs. To me it appears that the subdivisions of the palace car, which I omitted to state are movable at a distance of three inches all through the length of the vehicle, are good. So are the passenger-car springs; so, likewise, are the appliances for feeding and watering. But to render the improvements complete, the traverses must be padded where they are sure to come in contact with the points of the occupant of the car, and that the front and rear of every individual stall must be a doorway, independent of the neighboring stall. Under this system horses and cattle can be loaded and unloaded so quickly as to save much time, and the expense of erecting new or remodeling existing shutes, would be so trifling as to be covered by the economies effected in one trip from Chicago to New York on the aggregate amount of horned cattle transported in one week. It is not now my intention to seek to harrow up your feelings by a sensational account of the sufferings of dumb beasts; to tell you that they gouge one another's eyes out; that they gore one another's flanks; that cattle men act like fiends rather than like human beings; that cattle go mad from thirst, and that they drop dead from exhaustion caused by hunger and fatigue. But I hope to have shown you that an enlightened, humane system is most in accordance with your mercantile interests, and that it is better to save three dollars than to lose five dollars with the hope to gain six dollars. In conclusion, I would venture to suggest that Mr. Street be invited by this enlightened and progressive body, to study and adapt, always subservient to your approval these my proposed modifications of his improved and patented palace car for the transportation of live stock. After years of experience I am fortunate enough to be able to say that I never lost a beast in the course of transit, although I have conveyed horses, many thousands of miles by land and water. I can also say that while on land journeys or voyages, I never allowed my horses to lie down. When the transit is too long to allow horses and horned cattle to remain on their feet, the only safe way to rest them is to use slings. There are other improved railroad cars for the transportation of horses used in this country, but they are crude in idea, and their construction evinces a sad want of knowledge of the requirements of dumb animals on the part of the contrivers thereof.

The Chairman.—I am sure we all heartily adopt as ours the sentiments of this excellent paper. I have sometimes thought that the happiest month of a man's life would be that in which he should speak no cruel or unkind word either to his brother man or to beast; not even to the dog when he runs out of the house with the steak he has stolen.

Apple Trees that Never Bloom.

Mr. H. L. Reade.—Some time last spring there was considerable talk about apple trees that never bloom, and yet were productive. Hon. Jesse S. Ely, of Norwich, Conn., has handed me specimens that came originally from his father's farm in Litchfield county, and from a tree that has had no perceptible blossom and yet has borne for over fifty years. The shape of the blossom end is very peculiar, and if

Mr. Fuller will dissect one, and make such remarks as he shall see fit, it will be of interest to all who participated in the former discussion or read about it in the papers.

Mr. A. S. Fuller.—Mr. Ely has not examined closely, or he would have found that his trees do bloom. We have in these specimens the proof that these are blooms—not perfect, however, because there were no petals, and this is why the man thinks there are no blossoms. The petals in almost any flower is merely an ornamental organ and not essential to the production of fruit of pulp. These apple blossoms had a calyx, for it is now upon them ; they also had pistils, for they contain seed and probably stamens, as I find the dried up fragments of the same within the calyx. If our correspondent will examine his apple trees very carefully he will find that they do really bloom, although the flowers may be inconspicuous on account of an entire want, or deformed petals.

PEARS FROM PACIFIC SLOPE.

The chairman showed some pears of a fine size and appearance, and explained that they were specimens of a consignment brought all the way from California in a Davis Refrigerator car. This car contained nine tons, was twenty-two days on the way, and the fruit arrived in perfect order. He expressed the opinion that when it is generally known that on a given day a cargo of California products would arrive in New York many lovers of fruits would literally lay in wait, and go for the good things with a vengeance.

MILK COOLER.

A contrivance for removing the animal heat from milk was shown by the inventor and explained at length.

Mr. J. B. Lyman.—The farmers of this country need some adaptation of this sort, but there are so many ways of accomplishing the end that a patended article can never have an extended sale, unless it is remarkably cheap. It is only in July and August that such devices are useful, and then if a farmer has a good cool spring-house that is better than all the patents. But the real want is not so much of a milk-cooler as a cow-cooler. When a cow runs in an open pasture where the sun falls on her, and the flies tease her all day, and the mercury stands among the eighties, and sometimes in the nineties, as was the case for nearly six weeks last summer, the animal becomes feverish, and all the ice in the North river would not prevent her milk from acting wrong in the vats and giving floating curds. During such severe weather the true policy is to keep the cows through midday in cool, dark stables, and sprinkle the floors with saw-dust, wet with dilute carbolic acid. This will rid them of flies. As to cooling the milk, I remember that two years ago we went up to Warren Leland's to see a cooler that was nothing more than a coil of half-inch tin, or tin-lined lead tube in a common wash-tub. Ice is put in the tub and the milk is run through the coil. Mr. Leland has used this coil two years, and he wants nothing better.

SELLING VEGETABLES AND FRUIT BY WEIGHT.

Mr. P. T. Quinn, read the following paper:

From the way in which vegetables and fruit are now sold in nearly all the States, at so much per bushels or barrel, it is difficult to make any estimate beforehand on the weight or bulk of a bushel or barrel of potatoes or apples. A bushel of potatoes will vary in weight from forty-five to sixty pounds, and of course the same discrepancy will be found between barrels of vegetables or fruit. At present there is no standard weight for a guide, and it depends upon the honesty of the person who measures the articles, whether the buyers gets a long or short bushel or barrel.

Last spring I bought a number of barrels of Early Rose potatoes at so much a barrel. When these barrels reached my farm none of them were well filled. In a number of them there was an empty space of from six to eight inches between the lid and the potatoes. When measured a number of the barrels were found to hold but two bushels and a peck, while none of them ran over two and a half bushels, although a potato barrel is supposed to hold two bushels and three pecks, good measure.

The dealer from whom I bought these potatoes said, when his attention was call to the fact, that the barrels were not well filled, informed me he could do nothing about the matter; the potatoes came to him in the same way, and a "barrel was a barrel, whether it was well filled or not." Under the circumstances there was nothing to be done but to put up with the loss.

Of late years potato and apple barrels are made smaller each year. During the present season I have seen hundreds of barrels of apples and pears in New York market, which would not hold more than two bushels and a peck each when full, and it is quite common when the producer sends his produce in large sized barrels for the "middleman" to transfer a part or the whole into smaller sized packages.

With producers who are situated near a market, and where a large share of their produce is sold on a farm to hucksters in lots of from ten to twenty bushels at a time, it is a constant source of annoyance between the seller and buyer about how much constitutes a bushel of vegetables or fruit. In case the article is scarce and high-priced, the grower insists on giving only a small bushel. That is, the measure is only filled and made slightly rounding on the top. On the other hand, if the same article is abundant and cheap, the buyer demands in return about as much heaped above the rim of the bushel measure as there is below it; and then he is not always satisfied without several shovelsful are thrown in for "good measure." This same performance has to take place over again between the dealer and consumer, and in this case the latter is not likely to get more than the "law allows" in the way of good measure.

A few years ago I knew of an instance where a market boy, who had the reputation of being a skillful hand at measuring, received from his employers $300 a year extra pay for his known ability to cheat in giving short measure. He did this so adroitly and so rapidly that the purchaser might watch his movements carefully and detect nothing wrong at the time. By this means of giving short measure, his employers could undersell the market rates and always draw a crowd of buyers, who supposed they were getting their produce cheaper than they could elsewhere.

There are but few persons who have been in the habit of buying family provisions in small quantities, who have not, at times, been surprised in the difference in quantity of different half bushels of apples, potatoes, carrots or turnips. With vegetables, like carrots, beets and large-sized sweet potatoes, it is almost impossible to measure with accuracy. It may with fairness be supposed that the huckster is likely, under the circumstances, to favor himself instead of the buyer. The same is noticeable with cabbages. In a lot of 100 heads of cabbage, say at ten cents per head, there are hardly two of the lot that are of the same weight. They will vary from four ounces to two pounds, as the case may be. Still, there is no way of being any more accurate under the present system of guesswork. Shrewdness on the part of the buyer may sometimes get the best of the bargain, but there is no certainty whatever of getting an equivalent for the money. It would be better for both producer and consumers if vegetables and fruit were sold by weight instead of measure. Take, for instance, cabbage. The head is placed upon the scales, and in case it weighs ten pounds, and the price is, say one cent a pound, the point is decided at once, and the buyer is then satisfied that he gets a fair compensation for his money. It would be much less trouble to the huckster, and ten times more satisfactory to the buyer, to have weighed ten, twenty or thirty pounds of parsnips, carrots or onions, than to have them measured. In one case guessing must always be called into requisition, while in the other the scales would truthfully indicate the quantity.

In 1864 I contracted with a firm in New York to raise sixteen acres of cabbages at a fixed rate per ton. These cabbages were grown and delivered without a single misunderstanding between the contracting parties. Every head was weighed, then the weight of the wagon deducted, which left the net weight, and there was no room for dispute or misunderstanding. In my experience in growing vegetables for market within the past twenty years, the two years during the late war that I contracted to grow cabbages by weight gave me the least trouble and most satisfaction in the end. Each head counted for its real value, and the scales decided, from which decision there could be no appeal.

Wherever the selling of vegetables and fruit by weight has been fairly tested, the system has given general satisfaction. In California all of the farm and garden products are sold by the pound, instead of the quart. Instead of asking for a peck or half bushel of potatoes, the customer asks for so many pounds, and the article is weighed at once, without confusion, and in less time than it would take to measure the same quantity. A barrel of potatoes calls for so many pounds; and, in case of short weight, the dealer is responsible, and is compelled to make it up. Strawberries, raspberries, blackberries, in fact all the fruits, are sold in the same way, at so much per pound. While visiting California during the summer I took pains to make close inquiry to learn how the system works, and found it gives general satisfaction to all parties.

There is no good reason why vegetables and fruit should not be bought and sold by weight as well as grain. It is not any more difficult to weigh a barrel of potatoes than it is to weigh a barrel of flour. For the past three years I have urged the passage of a law by the Legislature of New Jersey regulating the sale of vegetables by weight. Although not yet successful, owing to a strong opposition, I will continue urging this measure until I hope some day to get the law passed.

Adjourned.

November 8, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

TRANSPLANTING TREES.

Mr. John Broughton, Salem, N. Y., asks if sugar maples, three or four inches through, can be moved without killing them, and if so, when.

The Chairman.—He can move them; but must be liberal with his labor, and make broad holes. As to the time, let him arrange for it now, and move late in the fall or in winter.

Mr. D. B. Bruen.—And don't cut the roots, but spread them out well.

Dr. Isaac P. Trimble.—And prune the tops.

Mr. H. L. Reade.—As an additional suggestion, I may mention that it is a wise way to put plenty of good soil down close to the roots. When a man has trees to reset, he should make a special compost heap by piling turf, leaves, chip dirt and wood ashes, using a little lime for a solvent. When this pile rots down and becomes soft let him shovel it over, and if he has it, mix in a bushel or two of bone-dust. In setting out a tree, wheel a good generous barrow-load of the compost to the hole, and stamp some of it around the little roots, and mix it with the earth as he fills in. When nature manures her forests she does it with rotted leaves, and we cannot be wiser than she is in such matters.

Dr. J. V. C. Smith.—In Paris, when they were building the boulevard, great numbers of large trees were moved, being taken up with a quantity of the soil in which they grew. In Boston I saw some experiments which proved that it is easy in winter to make such transplantation, even when the trees are tender fruit trees, taking a ball of frozen earth with each.

The Chairman.—In Stamford I saw some very large elm trees removed in this way when they were asleep, and they never seemed to wake up to a realizing sense of their transition, but kept putting out each spring as if nothing unusual had happened.

VALUABLE REPORTS ON POTATO GROWING.

Mr. E. D. Hinds, Brandon, Vt.—Breeses' No. 6, or the Peerless, is a universal favorite. In this locality no other yields or cooks at all well in comparison. I planted the past season four barrels, cut to the single eye; have raised over 400 bushels from them; raised on good loam land, not extremely rich, without any artificial manuring.

Mr. P. J. Ward.—I planted two tubers of this variety and got two bushels in return.

Dr. Trimble.—I planted one Peerless and dug twenty-three pounds. Mr. Goldsmith, a neighbor of mine, says he got eighty pounds from one. This indicates that the product is enormous; but as yet I have not seen any person who has tested their table qualities. I will do so and report.

The Chairman.—The Peerless are very handsome withal. At the late fair of the Institute a case of them exhibited by Bliss & Sons attracted deserved attention for this reason.

Mr. P. T. Quinn.—The yield of the Peerless in some instances has been extraordinary. In the early part of April last I gave to Mr. D. E. Tichenor a single potato of this variety that weighed only half a pound. From this potato Mr. T. cut fifteen pieces, each having only one eye. These pieces were planted in good ground, in a row twenty feet long, and covered with about three inches of soil. In due time fifteen sprouts came through the surface. These were carefully tended during the growing season. No weeds or grass were permitted in or near the row, and the surface was kept loose by frequent hoeings. Early in September this row of potatoes was dug, and the yield was a trifle more than a bushel and a half, and the actual weight was 102 pounds. More than three-quarters of these potatoes are larger than the specimen I gave Mr. Tichenor, and a number of them are at least twice the size. This statement I know to be correct, for I gave Mr. T. the seed, measured the ground, and examined the product a week after they were dug.

Mr. A. W. Hamilton, superintendent of the Western Experimental Farm, wrote as follows from Indiana, Penn.: I propose to give you the result of my experiments made during the present year. Planted the first plot April 27, on ground previously in potatoes. I plowed with a Michigan plow, and applied four loads of compost; harrowed and rolled, furrowed out the ground three feet wide, planted the potatoes, white Utica, two rows of large and whole, which yielded 889 pounds; two rows of cut potatoes yielded 776½ pounds; being an increase of large and whole over cut of thirty bushels to the acre. Second plot, planted April 2, red Utica, two rows yielded 992½ pounds, large and whole; two rows cut yielded 734 pounds, being an increase of thirty-six bushels to the acre. Third plot, plowed with common plow, manured and worked the same as above, planted with Early Goodrich, April 30, two rows, large and whole, yielded 1,049½ pounds; two rows cut yielded 804 pounds, being an increase over cut seed of thirty-two and a half bushels to the acre. Fourth plot, plowed with common plow, manured and worked the same as No. 16, planted potatoes, Peachblow, May 5, two rows medium yielded 689 pounds; two rows small seed yielded 442 pounds, being an increase of thirty-seven bushels in favor of medium size seed over small seed. Fifth plot, sod, plowed April 20, four loads of barn-yard manure, harrowed and rolled, furrowed out three feet wide, four rows to the plot, potatoes, Peachblow, planted May 7, one row, large and whole yielded 398 pounds, one row medium yielded 361 pounds, one row cut yielded 353 pounds, one row small yielded 302 pounds, showing an increase of large whole over medium of twenty-one bushels, large whole over small of fifty-one bushels, large whole over cut of twenty-four bushels. These have been practical tests of the sizes of the potatoes. The plots are one-eight of an acre each, twenty rods long, one rod wide. I have tried other experiments with potatoes in the use of different fertilizers, which I will report at another day.

The Chairman.—This is certainly a very valuable record of interesting experiments, for which we are greatly obliged.

Mr J. B. Lyman.—It does not seem fit, Mr. Chairman, for a statement so careful and circumstantial as this, to be read and passed without comment. The great want of our agricultural literature is an authority which all will respect, that may fix certain propositions so as to stop all future debate on the subject. As matters now stand in this country there is an endless dispute whether five and three make eight or not. When two figures are presented some say they read sixty-six; others turn the card and maintain that it is not sixty-six but ninety-nine. For instance, some contend very stoutly that all lands, except a few porous alluvials, should be stirred to the depth of twelve or more inches. Others insist that three and four inch plowing is always and everywhere enough. The statement is put forward quite confidently that farmers can save from twenty-five to thirty-three per cent by cutting and cooking the winter food of farm animals. Others insist that cooked food is against nature, and never in the long run profitable. Now experiments like these tend to fix some things, to anchor some truths so that we may pass on from them to true discoveries and valuable progress. I remember that our worthy and most valuable member, Dr. Hexamer, some three years ago, gave us an important paper on this same subject. His conclusion was the same here reached; that planting one large potato would give in field culture better results than using either small tubers or sections of a large tuber. But he found the difference so small that where the price of the seed was high, as over a dollar a bushel, it would not pay to plant large, uncut potatoes. This experimenter finds that he gets from twenty to fifty more bushels per acre by using large, uncut seed. May we not consider it as proved that no seeding is so good as to use large, whole tubers, and that it should always be done when seed is not dear? We can thus keep one mooted question at rest by reference to these experiments.

WASHINGTON TERRITORY.

Mr. E. Meeker, Olympia, Washington Territory: This is not strictly an agricultural country, although we have much good land in our river bottoms, tide land and small valleys. Ten beautiful mountain rivers pour their waters into Puget sound, becoming less turbulent as they approach tide-water and forming an alluvial deposit, rich in fertile material from the mountain side, upon which alder, ash, maple, and balm spring up and grow, and have for centuries mingled their leaves and decaying trunks with the soil, thus forming a quick and very fertile soil for the husbandman. This is emphatically a timbered country, the best, we think on the continent. Ship-building and the fisheries are being developed, and together with the lumbering business already established, furnish a ready and remunerative market for all the farmers raise. The climate and water are well adapted to the dairy business. The ground is seldom frozen for more than a month during the winter, and grass grows from March to December. The summers are pleasant, the nights always cool and bracing, and the days not excessively hot. Although in latitude forty-seven degrees, the mean temperature for the whole year is that of central Ohio, but the extremes are less. Land is cheap, and to be had by preëmption and homestead, but little by private entry. We have a healthy climate, ready markets, new-formed settlements and mixed husbandry to offer to the emigrant. We shall have small farms, high culture, and large returns. This new north-west will be the New England of the Pacific.

DEVELOPMENT OF THE PEAT INDUSTRY.

Mr. T. H. Leavitt, Boston, Mass.—The peat enterprise is progressing well, in some respects better than I had anticipated for this season. I hear of operations in Connecticut, Rhode Island, New York, New Jersey, Michigan, Indiana, Iowa, and Canada, some of them on a large scale, and producing thousands of tons. Others are expecting to improve their peat beds next season, and several are preparing to extend the works already in operation. The cost is variously stated at from one dollar and twenty-five cents to five dollars per ton, but those who have done the most at it corroborate unqualifiedly the statement I have always made, that it can be produced in good shape at a cost for labor not exceeding two dollars per ton. My own works at Lexington have been run for the fifth season with entire satisfaction. The actual demand for the article in quantities from large consumers of fuel is frequent, and there are many peat meadows now lying unimproved and apparently valueless which with comparatively small expenditure might be made to yield handsome returns for the fuel to be produced from them, and for which customers are ready and waiting in numerous railroads and manufacturing establishments.

Prof. J. A. Whitney.—The value of a fuel may be estimated from its chemical composition, for we know the relative quantity of heat given out by different per centages of carbon and hydrogen in combustible materials. Without going into details of the calculation, I find that peat is worth about one-half as much as anthracite coal, as far as mere heat is concerned. Peat contains little or no sulphur, and will not destroy copper, for example, in locomotive fire-boxes, as anthracite does. The use of peat is simply a matter of buisness economy. If it can be brought to the consumer for one-half the price of coal, it will come into common use, otherwise not.

The Chairman.—Peat is an excellent fuel early in the season, before the cold is sufficient to require hot fires. Then peat I have found next to wood, and I have used it with great satisfaction. At the late fair five tons were furnished, and those who used it under the boilers spoke very highly of it, and they said the boilers would last much longer if peat were always used in place of coal. I think we have labored under a mistake in regard to peat, and I hope I may live to burn it largely.

Mr. J. B. Lyman.—I have watched with much interest the recent revival of the attention to peat. Some years ago there was a peat fever, and everybody who caught it suffered. One I know lost $30,000. But this inventor from Canada, who is working at Meriden, has a method greatly superior to the old mill, and it promises great things. So far, the people have felt a languid interest in it, because he has only pressed peat on a large scale, and for one railroad, and we do not care whether one of Vanderbilt's roads pays six dollars or sixty dollars a ton for their fuel. But the inventor is perfecting a small mill and press; he calls it a one-horse power, and says he can sell it at $150. With it six men can go to a peat-bog, and if the distance they wheel the wet peat is moderate, they can take out, press and lay on the grass to cure, six tons of the fuel in a day. For cooking purposes, the families of this country use about twelve cords a year in their stoves. I think a ton of peat will go as far in a cooking-stove as a cord of wood, and about as far as a ton of hard coal, because it makes a mild, regular fire. Everybody who uses anthracite for cooking knows that it throws out a great excess of heat.

Mr. Ely.—That is, a man can prepare a ton a day with the machine and the horse.

Mr. J. B. Lyman.—Where wood is not remote, a man and a horse can cut and bring to the door-yard a cord in a short winter day. Suppose the ton of peat to be equal in heating power to half a ton of anthracite, and to a cord of wood, the relative cheapness of peat can easily be reckoned. It exists in vast quantities; there are towns in New England where one-tenth of the surface is boggy, and covering more or less peat. Some beds are known to be fifteen feet deep. It is cheerful to remember that when the firewood is cut and the coal mines begin to fail, we have something to fall back upon that will give us motive power for our industries and comfort in our homes for the centuries to come.

Mr. H. L. Reade.—I hope that the influence of this Club will be given in favor of the development of our country's resources, rather than against. Peat is some time to be used for innumerable heating purposes, and the sooner it becomes an article to be found not only in the markets, but in our shops and our houses, the better. The fact stated by the chemist that peat has only half the heating power of hard coal, pound for pound, does not, to my mind, prove that it must always be an inferior fuel; and I trust our learned but rather skeptical friend will not die so young as not to see peat replacing coal in a great number of furnaces and grates. I judge that this is to be, for the reason that a considerable section of this country is under the necessity of transporting from Pennsylvania, several hundred miles, all the coal used in the various industries, as well as all that employed for cooking and the comforts of families, when peat beds are to be found at a little distance from the places where this consumption is both large and constant. Besides, all the timber now growing in quite a portion of the country is needed for timber and boards, and especially for railroad ties. The demand for the last named is constantly increasing, and is already up to, if not beyond, the supply. When our roads were first built, the average price of ties was twenty-five cents apiece. Now it is fifty cents, and rising a little every year. I therefore welcome as a benefactor any man that spends time and money and brains in the development of this business, and look with confidence to the time when it will be a cheap and very common article of fuel.

Prof. H. E. Colton.—I am of opinion that peat will eventually replace charcoal in furnaces. I am told that it makes very good iron, and I am also told that in some localities charcoal is very expensive, even twenty cents per bushel.

TOMATOES FROM CUTTINGS.

Mr. George Henning, Saratoga Springs, N. Y., says: About the latter part of January or the first week in February I sow the seeds thinly in a well prepared hot bed, in rows six inches apart. When the plants are five or six inches high, cut off the tops above the seed leaves; but so that the cut is close below the joint or leaf following up. Having in readiness a hot bed newly made, and where the bottom heat is say from seventy to eighty degrees, I take these cuttings and transplant four inches apart, in rows six inches wide, water well, and keep the window closed for about eight days, only giving, should the heat rise too high, on the corner, a little airing for the escape of steam and surplus heat. For the same time I keep the bed shaded from about ten to three o'clock, and give the plants occasionally a showering overhead. If the bed is warm enough in from four to eight days they have made roots strong enough to support the young plants. Then I give every day less shade and more airing, to grow them stalk and to harden them. When everything is favorable the plants soon commence branching out, and want more room. As the weather is now so far advanced (middle part of April), I take every other plant and transplant on cold frames, six inches apart each way, where, if severe weather sets in, I can protect them. This, too, will give the remaining plants room enough to keep there till the latter part of May or 1st of June, when they are all transplanted in the open field. Now, the beauty of all this the plants grow stronger and bushy, branching out nearer to the ground they bear transplanting so well, the roots are so close together and keep without any care the earth in a compact mass, so they never wilt down for a day, and grow all the time. I am not learned enough to demonstrate how it is that those plants, raised from cuttings, bear and ripen the fruit earlier than plants raised from seeds; but it is a fact well known by experienced gardeners that cuttings of most all kinds of plants blossom earlier and more freely than seedlings. It is a fact, too, that seedlings of fruit, like apples, pears, oranges, etc., will take a long time before they come in bearing; but take a cut of the seedling and graft it on the same or on another tree, and we will have in a year or two the fruit. Well, I think on the same principle my cuttings of tomatoes will blossom and bring fruit earlier than common seedlings. Plants where I take off the cuttings soon start out again, and by taking good care of them give tolerable good and bushy plants, but not as early fruit as cuttings. The soil, where I intend to raise early and good tomatoes, must be of light or sandy texture, dry, well enriched with manure, and open to the sun all day. I can't raise on poor soil a rich tomato, nor have the fruit as early and in such quantities as to pay for the raising. The poorer the soil the slower the growing, consequently later setting of fruit; but give plenty room for each plant, at least five by six feet apart, leaving the vines equally distanced around them, so that air and sun can act up to the center. I am gathering an average, from each hill, of at least half a bushel of good-sized tomatoes. Do not stake or trim up the vines, but let them lie on the ground; the fruit will have a better flavor, take up the heat from the soil, and ripen better, too. Only where the soil is cold, stiff or wet, would I advise to stake, or lay some brushes on the ground, or to cover the soil with tanbark or sawdust, to let the vines run over.

Value of Seaweed.

Mr. W. F. Howes, East Dennis, Mass, desires to be instructed as to its fertilizing power. He stated that it is used quite extensively in his vicinity, mostly after it has been used as an absorbent in barnyards and pig-sties.

Mr. D. B. Bruen.—Years ago, in Monmouth county, N. J., a man raked seaweed and spread it on his lands. He was the only one who followed the practice, and his farm after a while came to be like an oasis in the desert.

Prof. J. A. Whitney.—Seaweed contains mineral elements of plant nutrition, but notably a much greater proportion of soda than land plants. Before the process of making soda from common salt was discovered, seaweed was gathered on the coasts of Europe and burned. The ashes of seaweed, on the shores of Ireland and Scotland, were called kelp, and contained from six to eight per cent of soda. Those from Spanish weed were called barilla, and contained three times as much. It has been used as manure in Europe from immemorial times. Its beneficial action is not confined to supplying plant nutriment, but, when plowed under, its decay produces the same chemical changes in the soil as does that of ordinary green manures.

Mr. J. B. Lyman.—At the Cape May County Fair, the man who took the prize for corn was solely indebted to seaweed plowed under. He thinks he raised sixty to seventy shelled bushels per acre with it; and without it, by actual experiment, he raised only about one-fourth as much.

Mr. H. L. Reade.—Mr. Albert L. Avery, a man well known in eastern Connecticut as a successful farmer, uses immense quantities of this fertilizing material. His estimate of it is so correct, and his use it of has been so long continued, that I venture to suggest that he be applied to for information on this subject. There is no doubt but that the loss to the country is large, by reason of the waste that comes for lack of knowledge on this subject.

Mr. J. B. Lyman.—The farmers on Long Island sound, especially on the Connecticut side, are skeptical with regard to the value of seaweed, and thousands of loads are left to decay which should be utilized, and any positive information on this subject from the source suggested will be valuable. There is a great difference in coasts as to the quantity of fertilizing matter that can be obtained. On Chesapeake and Delaware bays, for instance, and on the Jersey coast below Long Branch, the spring tides throw up vast quantities of seaweed, and the mud of the sounds and inlets is full of mussels. The king crab also is found on the beaches in the spring in great numbers. A farmer can get a ton of crabs for eight dollars, and when crushed and composted with peat the ton is worth, at least, twenty dollars. So of mossbunkers; they can be caught by the million, and two of them thrown in a hill of corn will go as far as the best yard compost. In short, if I were called upon to select a hundred acres of worn-out land, and to make it rich by economical outlay, I would choose a seaside farm.

THE PRICE OF SUMAC.

Mr. A. Chandlee, Sandy Spring, Md.—Where is the market for it, and what is it worth per hundred pounds in the cured state? It is gathered about here and in the neighboring counties of Virginia, mostly by poor people, or by farmers' boys, who wish to make some spending money; and I notice that the people who gather sumac never get rich, for the traders only give one cent a pound for it, just about the price of hay, and it requires five times as much work to gather it. The sumac dealers are said to grow rich. Cannot the gains be more fairly divided?

Prof. H. E. Colton.—We need some $300,000 worth in the tanneries of this country. The price paid by those who use it varies from fifty dollars to $100 a ton. That which is free of sticks is much the best, and a third more is paid for it. If pickers would gather the leaves only, and then pay a small toll for grinding, and ship direct to the tanneries at Wilmington or Newark, they could receive at least sixty dollars a ton instead of the twenty dollars they get now. But the difficulty is that people who pack sumac leaves do not take good newspapers and never know how to market. They are at the mercy of traders, and work for nothing, and stay poor rather from lack of knowledge than want of industry.

ALKALINE SOILS.

Mr. W. Martin, Kansas.—I have recently commenced reading the proceedings of your Farmers' Club. I am a settler upon the Cherokee neutral lands in southern Kansas, and together with the rest of the community am desirous of information pertaining to an injurious element in our soil which puzzles everybody, and we would gladly be rid of it if we knew how. The element referred to is here termed alkali, and I presume is the same thing so common in Dakota, and other places west of the Missouri river. With us it is met with usually in small patches, varying from a few square feet to an acre in size. Nothing grows upon it of any account, and after the seed is planted, it does not even sprout. At times the alkali cannot be seen, and again the ground has the appearance of having been sprinkled with slacked lime. The water in most of the wells has a bad taste, and is so hard that it will not answer for washing, even with the addition of the strongest concentrated ley. Vegetables, and sometimes meat boiled in it, have a bitter taste. Potates taken from it are covered with a white powder on the surface. Beans cannot be boiled soft in it in twenty-four hours. These peculiar phenomena in the water are attributed to the presence of alkali. Iron vessels used in it are soon rusted out. Now can your Club tell us what this alkali is? Can it be got rid of, and how? Can the water be purified, and how? Will manure help the alkali spots?

Professor James A. Whitney.—In traveling across the continent last summer we began to hear of alkali when we were a few hundred miles west of Missouri, and the evidences of its presence in the soil, and in the water grew stronger as we advanced, till in the Humboldt valley we ran for hours through the alkali flats, a region made hopelessly desolate by the excess of noxious elements. At some remote period in the wild history of this planet an ocean covered all the west of this continent. As its brackish waters receded they left a mud charged with brine. This brine was made up of chlorine, soda, and magnesia. The action of air and rains has been to dissolve the salt and remove a part of it, carrying away the chlorine, but not the soda nor the magnesia. In Utah they have had a long contest with what they call saleratus land. Time, cropping, and water are the remedies for the soil. Mr. N. C. Meeker, at his prosperous colony, spoke of finding some, but not enough to be mischievous ; besides he draws his water from the snow-clad peaks of the high mountains 100 miles west of the plain where Greeley is situated, and needs no wells. Irrigation is the sovereign remedy where water can be obtained. The bitter stuff can be washed out. Probably the best way in Kansas would be to plow these spots in a ridge furrow late in the fall and let the winter rain leach through the earth. As for the water, the substance to fight it with is not another alkali, but some acid. If he will send us on a bottle of the bitterest water he can find I will make some trials, and think the addition of a little strong vinegar, or a very little sulphuric acid might neutralize the alkalies.

A CHEAP FRUIT-KILN.

Mr. J. K. Jenkins, Wyoming, Pa.—I find a great deal said about a certain machine for drying fruit, and its cost is only a thousand or two dollars. And another machine to dry fruit on a cooking stove, costing only five dollars. Now I will tell you how to dry fruit with a machine still less expensive. Take one, two, three, five, or ten mush-meal sieves of the same size, so the lower end of the hoop of one will fit into the top of the next, like the joints of a stove pipe. As fast as the fruit is prepared fill the sieves and stack them ; fasten them together with twine or wire, so that they are easily adjusted. Set your stack on the stove at night, keep a slow heat by banking the coal, and remove your fruit in the morning. The top sieve should serve as a cover. Turn the nest of sieves upside down once an hour during the day. Lay a paper over the top so as to keep out dust and to let the rarified air pass. This caps all other ways of drying fruit.

Adjourned.

November 15, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Axletrees.

Mr. Smith W. Butts, Shortsville, N. Y., desires to be informed "whether there is any difference in the draught of a load, say from two to three tons, on an iron axletree (to oxen), of two inches, or the thimble skin of three and three-fourths or four inches diameter? One costs $110, and the other $125. We want the lightest draught, and as we have nothing to test the matter, thought that by addressing you we might find out if this had been tried."

Mr. A. S. Fuller.—It is a familiar truth in mechanics, that the smaller the axle the less the friction. With this in his memory, our correspondent need not be at a loss how to act.

Transplanting Pear Trees.

Mr. Thomas J. Vickers, Chestertown, Md., stated that he had a pear orchard in which the trees are too close; ten feet each way, and every fourth one a standard. "Could I take them up at this age (four years) and re-set them with safety?"

Mr. P. T. Quinn.—Yes. It is not difficult to move pear trees, even those ten years old, provided the work be properly done. Cut back the tops and spare all the roots possible. Set the spade in, always keeping the edge toward the stem of the tree, at least four feet from it; six feet might be better if the roots run far.

Planting Dwarf Pear Trees.

A correspondent asks if dwarf pear trees will in time become standards.

Mr. P. T. Quinn.—We have in our pear orchard more than 1,000 large-bearing trees of Duchess d' Angouleme pears. They were all planted as dwarfs, that is, on quince roots, with a view, however, of their ultimately becoming standards. To help to insure this change taking place, the union between the pear and the quince at the time of planting the trees was covered with from four to six inches of earth; or, in other words, when the ground settled around the body of the trees, the union was from four to six inches below the surface. These trees produced fruit three and four years from the time of planting, and have continued to bear, with but few exceptions, every year since.

At present nine-tenths of these Duchess are virtually standards, having thrown out roots from the pear stock. Some of these roots are visible above the surface, and would measure from three to five inches in diameter. At no period during this change from the quince to the pear-root have we been able to discover any change in the appearance, size or quality of fruit grown on these trees. The size and quality have been uniformly good, even when carrying an overburden of fruit, as happens to be the case the present year.

We have some standard Duchess planted at the same time as the dwarfs. These standards have been very shy bearers, the fruit small, and decidedly inferior in quality, when compared with the fruit grown on the trees that have become standards since they were set in permanent place. This has been my experience with the Duchess in our orchard, and I know it to be so in many other places.

Where the experiment has been carefully tried, I am at a loss to know the cause of this strange fact in vegetable physiology, or why there should be any difference in the size, productiveness or quality of fruit when grown on the same soil, and under the same treatment. But there is a difference, and a very noticeable one, in our orchard, between the two standard Duchess; the one planted on pear roots and the other throwing out pear roots from the body of the tree, sometimes from three to five years from the time of planting in the orchard. The practical evidence is so striking in our orchard that if I were going to plant 10,000 Duchess d'Angouleme pears, 9,990 of them would be dwarfs, worked low, and in planting would cover the union between the quince and pear at least four to six inches with soil, to encourage roots from the pear stock.

EXCELLENCE OF ORCHARD GRASS.

Mr. F. D. Curtis brought some tufts of orchard grass, and said that he took them from a field which is so much exposed that he had found not a little difficulty in keeping it covered. At last he sowed the seed of orchard grass, and that answers an excellent purpose.

Mr. J. B. Lyman said orchard grass was found to thrive better in some sections of the south than in any other, and in this connection asked the audience to look at two or three specimens of

CHEESE FROM NORTH CAROLINA,

which, he explained, was made from the milk of cows fed upon orchard grass. The cheese was the product of the Elk Mountain factory, located in Buncombe county, near Asheville, N. C.

Prof. H. E. Colton.—The factory was established by the Hon. N. W. Woodfin, in 1868. It is run by W. S. Cornell, formerly of Ithaca,

N. Y. Through the assistance of Governor Seymour Mr. Woodfin procured the services of a Mr. Edwards of Herkimer county. Under the most discouraging circumstances he commenced. His operations were a complete success, financially as well as practically. Last spring Mr. Cornell leased the factory. He writes me that he can make more cheese in a year, and more cheese from a gallon of milk, than in any New York or Ohio factory he ever saw. He unhesitatingly pronounces that section of western North Carolina having Asheville as its center as, in his opinion, the best cheese making section of the United States. The region alluded to by Mr. Cornell has a length of over 150 miles and average breadth of fifty miles. The soil is a black loam, rich in potash and vegetable matter. There are hundreds of locations as good as Mr. Cornell's for cheese making, and land is cheap. This cheese factory, located on Elk Mount, four miles from Asheville, N. C., is about 4,000 feet above the sea level. They have a spring on their premises, of which the water never marks over fifty-five degrees, and numbers of more such are to be found all through this mountain region. The temperatures of the summers are even. Last summer the thermometer did not go over eighty degrees. The climate is one especially recommended to consumptives. It was in search of a better health that Mr. Cornell was first induced to go there. He says he has not only found a climate that suits him, but also a locality where he can pursue his old business with more profit than in New York. The southern market for this cheese is very large, and but little, if any, is sent north for sale. Of course, as manufacturers increase this must occur., and then it will be seen that the greater amount produced per year and per gallon in this Buncombe country will more than make up for the difference of freights. Besides, there is but little difference between freights thence to New York and from Ohio. At present there is no railroad to Asheville; but in a few days the Western N. C. R. R. will be within thirty miles. There unfortunately it must linger for a year, as the tunnel through the Blue Ridge will not be completed until about that time. This road connects east to Raleigh and Norfolk. Another road from Knoxville, Tenn., is within thirty miles, and, as no tunnel intervenes, may be there in a few months. The people are glad to welcome northerners among them, and glad to sell their surplus lands, of which they have hundreds of thousands of acres, from which a tree has never been cut. Numbers of northern men have visited this section in the past year, and many have settled there. Nearly all have written to me, and not one is displeased or ever said he was badly treated in any way. If any of my hearers will take a map and look at the western end of North Carolina he will see that it goes off in the form of an acute angle. This angle comprises eleven counties, all west of the Blue Ridge, containing over 8,000 square miles of land. I am safe in saying that fully two-thirds is good tillable cr pasture land; not a twentieth is fenced or under cultivation. It is there rich in soil, rich in tree growth, rich in minerals, rich in a climate that invigorates the feeble body and brings the glow of health to the cheek. It invites all to come, and its owners gladly welcome the settler and buyer. Through this angle will some day run the great through line from the Atlantic to the Pacific. A glance at the map and a measuring string will show this fact. Then all this region, with its wealth of beautiful scenery and fertile soil, will be appreciated. Speaking of the cheese, I may remark, in conclusion, that F. D. Curtis, who all know is a good judge of the article, requests me to say that, as one of the committee to test the cheese, he pronounced it very superior, first class in all respects but flavor. He thinks it needs age. And I hear around me, on all sides, expressions of surprise that such cheese should be made in North Carolina. I trust, sir, that the committee will make a full report, and that Mr. Lyman, who I learn is going soon to western North Carolina, will look into the workings of this factory and give us his opinion in full.

VEGETABLES FROM GREELEY, COLORADO.

Mr. Samuel Sinclair sends a box of vegetables grown in Greeley, Colorado, consisting of turnips, beets, potatoes, onions; also a fine specimen of wheat. The vegetables were of enormous size and very solid.

CULTURE OF ASPARAGUS.

Mr. P. T. Quinn.—For more than twenty years I have been accustomed to hear about the same class of questions asked by consumers, why asparagus, a vegetable always in good demand, and usually commanding high prices, was not more generally cultivated by farmers, as well as gardeners, situated favorably, and accessible to good markets?

During these twenty years I have been engaged, more or less each year, in growing vegetables for market, and at different times have known each and every kind of vegetable grown to any extent for market to be a "drug," with the single exception of asparagus, which so far has always been in good demand, and that too at paying prices

There are few persons who have been engaged on an extensive scale in "trucking" who have not been compelled to sell, in "bad seasons," a part, or the whole of a crop for less money than it cost to produce it. This would apply to the whole list of vegetables, leaving out asparagus, which during such dull seasons and poor markets, is generally made use of by those who grow it to work off other kinds of vegetables, that is, in case a grocer wants two or more dozen of asparagus, to get it he would be obliged to buy a portion of whatever the grower had on his wagon at the time. In this way the gardener who had an abundance of asparagus would not lose so much in the sale of his crops in dull seasons as he who was not so situated.

Within the past few years more attention has been given to the culture of asparagus, and it is not rare now to find fields of from two to seven acres in different sections devoted to asparagus for New York and other large markets. Some of these new plantations have already begun to yield, and still prices are not in the least affected, but on the contrary have advanced. The past season growers estimated the yield was above an average one, and still prices ranged higher than they have for many years. This condition of matters is quite encouraging for those who have young beds, or are about to embark in this branch of gardening with a view to profit.

To be successful in the culture of asparagus for market, there are a few essential points to be fully considered and carried out before any hopes of success can be entertained.

The first is a selection of the most suitable soil and situation. The second, a thorough mechanical preparation of the soil before planting, and third, heavy manuring.

The location of the bed is important, from the fact that when asparagus first comes into market, it sells briskly at from five dollars to eight dollars per dozen bunches, and frequently as high as twelve dollars per dozen, if the spears are large and the bunches carefully made. From these prices it gradually falls, as the supply increases, until it reaches two dollars per dozen, and very seldom goes below this price, although at $1.50 per dozen asparagus will pay a handsome profit.

When the soil has only been indifferently prepared, and poorly manured, earliness of the crop and large sized spears cannot be expected, and, as a matter of course, under such circumstances a large share of what would be the profits are not realized by the producer.

Sowing the Seed.—Asparagus seed should be sowed in the spring in a bed made deep, mellow and rich. When the surface of such a bed is raked over, removing any stones or other obstructions, then shallow drills should be opened about one inch deep and a foot apart. The seed is strewn thinly by hand in these drills, and then covered by raking the bed with wooden rakes, drawing them in the direction of the drills. Fresh seed will sprout in two weeks from the time of sowing in favorable weather. Seed older than one year will take longer to germinate, and if more than three years old, is unsafe to sow with any certainty of its ever coming up.

It is a good plan to scatter some radish seed in the drills at the time of sowing the asparagus seed. The radish will germinate and come up in a few days from the date of sowing, marking the lines of the rows. This will give a chance to run a scuffle hoe between the rows, destroying any weeds that may appear, and keeping the surface loose until the asparagus plants are well up. Then the spaces between the rows should be disturbed frequently, and no weeds or grass allowed to grow. Under favorable circumstances, well grown one year old plants will be strong enough for transplanting in the permanent bed. In case the plants are weak, it is better to let them remain in the seed bed another season before making the bed. Plants older than two years should not be planted, for more than likely they will fail to give satisfactory results. Those who only want a few hundred plants to make a family bed, will find it cheaper to buy them from some responsible person than to raise them from the seed. One pound of seed will sow a bed twenty by 100 feet, and if the seed is fresh will give about 15,000 plants.

Preparing the Ground.—When properly made, an asparagus bed will produce paying crops for a quarter of a century, under good annual treatment. There should be no short-sighted economy practiced in putting the ground in order. If the ground selected is naturally wet, or likely to become so, then by all means have it thoroughly underdrained. Asparagus can only be grown to the highest point of profit upon soil that is free from stagnant water, thoroughly pulverized to a depth of at least twenty inches, and then heavily manured There will be more satisfaction in planting only a quarter of an acre on this thorough scale, than in planting an acre under indifferent preparation and poor manuring. The ground should be thoroughly plowed and subsoiled both ways, and then plenty of well-rotted yard manure plowed under. The more manure that is applied, the more productive the yield will be when the plants are fairly established. Barn-yard manure, composted with the *salt and lime mixture*, will be found an excellent manure for asparagus.

Planting.—It has long been a mooted question whether the fall or spring was the best time to plant an asparagus bed. In most cases more will depend on the condition and tilth of the soil than the time the roots are planted. Where the soil is heavy and retentive of moisture, and long and severe winters, undoubtedly the spring is the best time. But on sandy or clay loam, and as far south as Delaware or Virginia, fall planting will do just as well, and often better, than spring planting, under similar circumstances. When the ground is prepared by frequent plowings and subsoiling for field culture, or the garden-spot thoroughly trenched with the spade, then the furrows should be run but three inches deep, and three feet apart each way. A single plant is set at each intersection, being careful that every root of the plant is stretched out to its full length, and then covered with not more than four inches of earth, if planted in the fall, and only about two inches when set in the spring. This light covering at first, or until the plants have started to grow, is the safest plan to follow. When the young shoots are three or four inches above the surface, then, by running a cultivator between the rows, the loose earth will fall toward the row of plants, adding a couple more inches of covering above the crowns of the plants, making in all from four to five inches in depth.

In garden culture, this second covering may be drawn over the rows by the hand-hoe, any time during the summer. A cultivator should be kept going between the rows often enough to prevent the growth of weeds in the bed. This will be found the cheapest method of culture. When planted in the fall, the rows should have a light mulch of barn-yard manure put on in November, and, in the spring following this mulch, with an additional quantity of manure, either barn-yard, fish, guano, bone-dust, or superphosphate should be applied, and all turned under early in April, or as soon as the ground is dry enough to work.

Annual dressings of common salt will improve the quality and increase the size of asparagus. There need be no apprehension of danger from the application of salt to asparagus. I have frequently put on as much as two inches in thickness, on different spots, on an asparagus bed, and then the young shoots came through this coating of salt without apparent injury. A dressing of twenty-five or thirty bushels of salt to the acre on an asparagus bed every second year will be quite enough, in connection with the annual coating of barn-yard, a compost to be applied in the fall or spring, as circumstances may dictate.

No asparagus should be cut from the bed the first or second year. Some growers carry this so far as not to cut any until the fourth year from the time of planting. In case the plants have grown vigorously, a third of a crop may be cut without at all injuring the plantation the third year. The amount taken off the third year depends altogether on the condition and vigor of the plants. In case they are weak, it would be poor policy to weaken them still more by cutting for market or home consumption too soon. In the fall of the first year it is a good way to throw shallow furrows from either side toward the rows, and then rounding them off with a hoe or a rake. This slightly elevated ridge will dry out sooner in the spring than a flat surface, and asparagus treated in this way will often make a difference in earliness of five or six days, which is an important item for those who grow it for market.

Early asparagus always brings higher prices than what comes in late in the season, and, therefore, every advantage by locating, character of soil, and treatment should be taken into consideration by those who are about to culture for profit.

Varieties.—There were only two varieties generally cultivated for market purposes until quite recently. These were the green and purple-topped. The identity of these two were frequently doubted by intelligent gardeners, and the size and difference in color attributed to location, soil, and heavy or light manuring. Two years ago S. B. Conover, of New York, introduced a variety under the name of "Conover's Colossal." For this variety Mr. Conover claimed extraordinary size of spears, and that it was equal in quality and productiveness, to those varieties, that were in general culture for market purposes. This claim had to be tested by practical growers before discarding old and tried for new and untried kinds. Many doubted that it was any other than what was cultivated on Long Island, and other asparagus-producing sections; I have watched the "Colossal" closely for two years, and firmly believe it is the best variety of asparagus that we have for field or garden culture. The spears will average twice the size of the common kinds, and the "Colossal' is equal, in my estimation, in quality and productiveness to any variety that I am familiar with. Plants at one year old will average as large as plants two years old grown on the same soil and under the same treatment, of the green or purple. In another article on this subject I will have something to say on the profits of asparagus culture.

After which, Mr. S. B. Conover exhibited and distributed a quantity of the roots of the Colossal asparagus to the members of the Club.

PRACTICAL USES OF LIME.

Prof. James A. Whitney read the following paper:

As a manure lime is useful to supply the per centage of mineral matter essential to the growth of crops and to work chemical changes in the soil. For the first named function there is commonly enough lime in natural soils, but for the latter there is seldom enough in marshy soils or in those containing more than ten to twelve per cent of humus or decaying vegetable matter. The amount of lime actually required to supply the needs of the various crops as a mineral constituent may be inferred from the quantity which the crop actually takes out of the land. It has been shown that an average crop of wheat absorbs a little more than twelve pounds of lime to the acre; barley, nineteen; oats, fifteen; beans, thirty-seven; peas, seventy; turnips, 102; potatoes, sixty; meadow hay, about forty, and red clover, 103. As lime is readily soluble in the proportion of one part in 400 of cold water, it will be seen that, aside from rare instances, there will naturally exist enough in the soil to meet all the demands of plant nutrition. The exceptions will be found on dry sandy soils containing little vegetable matter, and with these the supply should be cautiously administered in the form of thoroughly slaked lime, as this will exert the least corrosive action upon the scant per centage of humus, which, on such lands, should be encouraged and retained. In these cases, moreover, it will be best to sow the powdered lime along with the seed, using for the purpose a machine which keeps the alkaline dust from the sower's face and eyes. This mode of treatment may be assumed as also best for light dry upland loams cropped for a series of years with plants requiring the lime.

Lime, however, owes its value in agriculture essentially to its strongly alkaline character, which enables it to combine with acids to form stable compounds and to displace such acids from previous combinations forming substances injurious to plant life. In nineteen cases out of twenty, therefore, it is a specific for the sourness which both in soils and in muck heaps detracts in very many cases from the fertility of the one and the fertilizing capacity of the other; in using lime, it is necessary that the farmer should proceed understandingly, and this he is enabled to do by one of the simplest appliances of the laboratory. Litmus or test paper is porous paper saturated with a substance that possesses the curious property of turning red by contact with acids, and blue with alkalies. By taking a sample of soil, therefore, digesting or boiling it with rain water, and dipping into it a strip of the blue litmus paper, a red tint on the latter will indicate the presence of acids and show that the use of lime will be beneficial. The same test is recommended by Voelcker for detecting the presence of sulphate of iron or copperas, which is as poisonous to plants as to animals, and for which lime is also a corrective. The chemical action, however, in the two cases is different. With the acids alone it merely forms harmless or neutral compounds, such as ulmate and humate of lime, of little or no consequence one way or the other. With the copperas lime acts to wholly decompose the substance, leaving iron, oxyd, or rust, and forming sulphate of lime or gypsum, the former harmless, and the latter capable of exerting at least a slight beneficial effect after the manner of plaster. The litmus paper may be obtained from any dealer in chemicals in cities, and undoubtedly from most druggists in rural villages, and, from its cheapness and utility, should be used by farmers for the purpose indicated much more than it ever has been.

It is not enough, moreover, to know that lime is needed, but the character of this soil must be kept in mind, both in determining the quantity per acre and the form, whether as caustic, slaked, or chalky marl, in which it may best be used. Should the land be saturated with stagnant water, and bear a rank growth of wild grasses, no application of lime, no matter how caustic or how profuse, will do any good until underdraining shall have carried off the surplus water, and thoroughly opened the ground to the ready admixture of the alkaline material. Lime will do much good on land rich in organic matter, and where this exceeds seven to ten per cent, with a strong acid reaction by the test above mentioned, the lime should be used in the caustic state. This for the reason that, aside from the chemical action induced by it as previously explained, lime rapidly hastens the decomposition of organic matter in the soil, which, however valuable when existing in proper proportions, is of no benefit when these are exceeded. The manner in which this reduction of organic matter is brought about by caustic lime is probably closely analogous to that by which woody fiber is destroyed by potash, viz., by the abstraction of silica. Any one who has examined the base-board of a leach-tub will have noticed that the fibers of the wood have lost their firmness and assumed a peculiar texture. The potash unites with the silica, atom by atom, to form a silicate of potash. In the soil the lime, in a similar way, abstracts silica, to form a silicate of lime, while the other constituents, being separated or disarranged by the withdrawal of the silica, rapidly disintegrate and decompose.

To return to the per centage of humus or organic matter desirable in a soil. This cannot be stated with any accuracy, because it depends not only upon the character and proportions of the mineral constituents but upon the crops to be grown. A soil with much potash and phosphoric acid should have a good proportion of well decomposed organic matter to retain ammonia and supply carbonic acid, by which the solution of the minerals may be hastened. In general, the use of lime is indicated whenever the proportion of organic matter exceeds ten per cent. An easy method of finding the per centage of organic matter in a sample of earth is to take not less than two pounds of soil, place it in an ordinary bowl and put the latter into an iron kettle, with a layer of clean, dry sand, an inch or two thick, between. Place the bulb of a thermometer in the sand beside the bowl and put the apparatus on the stove. Keep the sand at a heat of from 215 degrees to 230 degrees for a couple of hours, or until all the water is expelled from the soil. Then carefully weigh the now thoroughly dried sample; put the bowl in the fire and keep it red-hot for a couple of hours, by which time the organic matter will be burned out. Wait until the sample has cooled, and weigh. The difference between the weight before and after burning furnishes the datum, from which, by a simple calculation, the per centage of organic matter may be readily calculated. Of course the bowl will crack in the fire, and some care will often be required to prevent it from falling apart and losing the sample, but by guarding against such a contingency the method will be found sufficiently accurate for all practical purposes. The quantity of lime to be used in any case must be dictated by the discretion of the farmer, and should be increased in proportion to the degree of acidity of the soil, and its per centage of humus. As a general rule it is better to apply moderate quantities, say ten to twenty bushels per acre per annum, through a series of years, than to give a strong dose at once, and, when convenient, it is better to plow the land and apply the lime early in the fall, so that its action may be well under way before the succeeding crop is sown. Where the organic matter falls below ten per cent, even if the acidity is pretty strongly marked, it will be more advantageous to use slaked lime, and when the per centage falls lower than five or six, the chalky material found in many parts of the country, and sometimes known as calcareous marl, may be employed to better advantage, especially as such soils, whether sand or clay, need the ameliorating influence of the humus as well as the acid neutralizing action of the lime, which, in a strong or caustic condition, would, as previously intimated, hasten the decomposition of the latter. If gas-lime is used, and is not properly managed, it is full of mischief to the field and of loss to the farmer, but, notwithstanding, it may be made worth from one-half to two-thirds as much as ordinary slaked lime. Gas lime should always be exposed to the open air, but protected from rain, for several months before it is used, and the mass should be frequently shoveled over, so that the whole may be subjected to the oxydizing action of the atmosphere. This done, it will make a valuable manure, but without this it will be a damage to any one who uses it. The *modus operandi* of the change is very simple. The oxygen of the air converts the noxious substance, sulphite of lime, into the useful sulphate of lime or gypsum.

Adjourned.

November 22, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Sugar Maples and Maple Sugar.

Mr. R. M. Clark, Roostown, Ohio, stated that for the last five springs he has been making sugar from maples which thirty years ago sprung up from the leaf-mould of timber land or "sugar camp." A few hundred of them escaped destruction, and are now a valuable accession to the camp; particularly so as the large old trees, from much boring and other causes, are dying off rapidly in this whole region. He is fully convinced that if trees with the disadvantage of growing up in the shade of the native forest will attain size enough for use in twenty years, that with open culture on rich, deep soil, half that time would suffice for producing like growth. The familiar attempt at roadside propagation of pole maples, from the large lower section of the tall forest-grown trees, is no adequate test of what young well-rooted nursery trees will do. "And yet I can show some prodigious maples, transplanted in that manner by my own hands thirty-three years ago this spring. And then again close by there is another row of maples transplanted by me fifteen years ago, of the size of my finger; have had some cultivation and manure, and are now from six to ten inches in diameter near the ground, and have magnificent tops. And still another row, close at hand, of such little slips of maples and elms transplanted by me (taken from fence rows near the forest) twenty-three years ago, are now notably magnificent maples and elms. Therefore, I reason that a thrifty young tree, the size of my penholder, three or four feet high, and three or four years old, everything considered, is the best size and age for transplanting. The time of year may be autumn or spring, as suits best. Only, if done in spring, it must not be till the sap stops flowing. As to the cheapest manner of obtaining them, I should say go to any hard maple forest, where last summer the maple seed sprang up and grew protected from cattle and sheep; pull up a hatfull, which will make a thousand or two of the yearling trees, which will be from four to six inches high; plant them in the garden, in rows two feet apart in the row, and rows as wide as corn; cultivate two years; then transplant them from twenty to fifty feet apart each way (or closer one way), where they will be beautiful, ornamental and useful for several generations. In a few years the house and barn, though humble in appearance, will have a charm around them which nothing else could give. In addition to the improved aspect and beauty of the homestead, think of the constant supply of excellent sugar evermore, after fifteen years' waiting, to come from the near grove. Five or six acres of my sugar camp, fenced off by itself, came up thickly with maples last summer, as I kept cattle and sheep out; and there are several millions of the yearling hard maples just right for transplanting to yards or gardens this spring.

HEDGES.

Mr. C. E. Blackwell, Titusville, N. J.: I have been surprised that nothing more has been said about hedges. For an ornamental fence the American arbor vitæ and Norway spruce for this section are the best. But for an ornamental and at the same time perfectly secure fence for all kinds of stock, the Osage orange has no equal. All that the Osage orange requires is the ground dry enough and rich enough to raise at the rate of fifty bushels of shelled corn per acre, and to tend it the same as a row of corn for the first and second years, with one or two plowings the third year. As to the winter killing, I have never seen it, unless the ground was very wet and the young plants were thrown out. In such cases the ground should be under-drained. The cold weather will not kill the plants in the northern part of New York State. True, when the fall produces late growth, the tops may be killed for a foot or more; but that should be cut off in the spring. So the cold does no damage, but with neglectful people it is rather a benefit. I have seen thrifty and secure hedges in the west, where the mercury often went as low as thirty degrees below zero. Of course, the Club does not expect to make a hedge of any fruit tree, and then turn cattle into the fields divided by it. The willow will succeed only on moist land, and should not be recommended at all. I believe the Osage will succeed all through the eastern, middle and most of the western States.

BUTTER IN MISSOURI.

Mr. F. E. Miller, Westport, Mo., stated that fifteen years experience in different sections of the west has convinced him that the west is not the place for the empty-handed. A little, even $200 or $300, is almost indispensable, and this may be acquired much more easier in the older States than in the new. For such as have entered upon a career of saving and accumulating, the west offers noble opportunities, the chances, other things being equal, being in favor of the larger capital. To those possessing considerable capital contemplating a westward move, he would say: If you can make good butter, if you know how to keep a lot of cows up to a full flow of rich, wholesome milk, I can tell you where you will find a ready and eager market at highly remunerative prices; where good fresh butter brings from fifty to seventy-five cents per pound, and the supply hardly one per cent of the demand; where fresh milk brings from ten to fifteen cents per quart (forty to sixty cents per gallon), and in eager demand; where eggs and poultry bring better prices through the year than in New York city, and that "where" is Kansas City, Mo., the great railroad center and metropolis of the west. Kansas City contains a fixed population of 35,000, and is growing beyond precedent. Eight railroads already terminate here, two more are being constructed, and manufactories are springing up on all sides. The demand for first-class dairy products will steadily increase. I have been running a small butter dairy this season, delivering twice a week to private families at fifty cents per pound. Buttermilk sells readily at twenty cents per gallon. Had I the capital I could increase my business tenfold. Poor butter brings from twenty to fifty cents wholesale through the year; but a good article is scarce, in fact, seldom if ever seen in open market, and commands its own price at all seasons. Various causes operate to produce this result, but chiefly the want of the requisite knowledge, skill, and capital.

Dr. Smith.—I have been over the ground of which our correspondent discourses, and I feel convinced that any man who goes there with skill can make more money in two years than here in a dozen. Yet people linger at the east, and complain of hard times, when, if they would take the tide at its flood it would lead on to fortune.

EXPERIMENTS WITH CORN.

Mr. Hamilton of the Western Experimental Farm, located at Indiana, Pa., wrote at length of certain tests made during the past season which seemed to prove, First, " An average increase of nearly fourteen bushels to the acre in favor of subsoiling, and that the plots planted with end grains only gave sixty pounds of corn more than those planted with the butt grains." Second, " That fifty bushels of lime increases the product thirty-one bushels on the acre ; 100 bushels of lime increases ten and a half bushels; while 200 bushels to the acre increases the yield to sixty-three bushels. I cannot account for the discrepancy between the application of 100 bushels and 200 bushels. Although we claim here that our soil will not partake of lime freely, this shows to the contrary, and leaves it open to a discussion as regards the application. Last year the lime was applied in the same manner with different results. I may further state, that it was the special instructions to have three stalks to the hill on all the plots, and these experiments were made upon this basis, except plot 423, one stalk at twelve inches. Other experiments have been made upon oats, barley, wheat, and grass; and as I am engaged in making out my annual report to be printed, I will withhold writing, and will furnish copies."

SEA WEED.

Mr. William F. Howes of East Danvers, Mass.—I am not a farmer by profession except in a small way, but have had a good opportunity of observing the result of the sea weed treatment on one particular farm where I was kept pretty closely to work from a small boy up to eighteen years of age. I then left farming to save my life, and after following the sea regularly for thirty years, I came in possession of a part of the same farm which had been managed during the thirty years by a man who believed in sea weed, and the improvement has been wonderful. The land that I could not then plow deeper than four inches without turning up the yellow dead earth we can now plow to six and eight inches, and turn up a dark, rich mold. Where we then raised nubbins, we now raise ears of corn at the rate of fifty bushels of shelled corn to the acre, which is probably above the average crop in this State, though some say they easily raise upward of 100 bushels and take premiums for it at the fairs. The land I have described has been in constant tillage and mowing, a rotation every five or six years, say two years in grain and three or four in hay, a good dressing of sea weed from the barn-yard and pigstye plowed under for each grain crop, and no other manure. Neighboring farms under the sea weed treatment have done equally well. We have had farmers among us who affected to despise sea weed, but they are about all gone, while all agree that it is a boon to the farmer.

FENCES AND FENCE POSTS.

Mr. A. Bradt, Skaneateles, N. Y., stated that in his neighborhood for several years the manner of setting has been with hydraulic or water lime and coarse clean sand or fine gravel, the proportion one of the former to four or five of the latter. It should be mixed thoroughly, rather thin, and the hole filled to the surface. There may be small stones thrown in as the hole is being filled, which should not be less than three feet deep.

REPORT OF THE COMMITTEE ON DARRACH'S COMBINATION FENCE.

The committee appointed to examine the combination fence pat ented by Mr. S. A. Darrach, of Newburgh, N. Y., reported, that they had carefully examined both the model and line of fence on Monticello avenue, South Bergen, N. J. The peculiarity of the fence is a cast-iron post, consisting of two upright parallel ribs of T shaped iron, diverging at the base, forming an inverted V, with flat feet spiked to a sill three and a half feet long, which is laid about fourteen inches below the surface of the ground, at right angles to the line of fence, thus giving ample facilities of anchorage, and securing a broad, firm foundation, not liable to be affected by frost. The sills being excluded from the air are not likely to decay. The base board passes through an opening in the center of the post; the railing also passes through the posts. The pickets are inserted between the buts, resting on the top of the base board. The rails are so arranged that they break joints on alternate sides, thus forming a continuity like one whole rail. It is claimed that this fence does not cost more than any corresponding style of wooden post fence, and that it is far more durable. In this claim we think the inventor is fully sustained by what we have seen. The fence we saw cost seventy-five cents per running foot; and we are informed that a wooden post fence of similar style cannot be made for less.

We can recommend the fence as light, strong, and, to all appearance, durable.

H. L. READE,
H. B. COLTON,
J. K. FISHER,
Committee.

FISH CULTURE.

Mr. A. R. Fuller, of Malone, N. Y.—My letter, published in the proceedings of July 12th, has brought many notes of inquiry. I have thought best to answer all at one time through your Club. First. Which are best, the red or light meat trout? I have tried to find the difference, but have not been able to find any difference in flavor or quality of fish taken from the same water. There is a difference in trout taken from different ponds or streams. Both colors are caught in the same water. As many prefer the red meat, we are keeping the two colors separate, and supply customers with either at the same price. Others inquire about "Patent Spawning Races." I do not approve of any *patent spawning race* that I have seen, and think all practical fishermen have or will discard them. Hard stripping, skillfully done, is in my opinion the way to handle trout or salmon. Each system will have its friends, and many new beginners will try anything new they see or hear of. Many ask when to begin; what time? I tell them now; they will be so much ahead for next year. If they start with eggs, they will have a crop of young fry to watch and study, and gain one year in growth. If they begin with old first they will be able to try their hand at stripping and hatching one year earlier than to wait until spring. Make the begining, no matter how small. Others ask, can I get along without a hatching house? Yes, if they wish to try the experiment on a small scale. Dig a trench in the ground and cover it over with boards to keep out the snow. Put in about two inches of ground and let in about the same depth of water, through a fine wire screen, with a screen at the outlet. You can then examine the eggs daily, and when hatched feed the little fellows in the trench or turn them out to take care of themselves. A trench ten feet long and one foot wide will accommodate 25,000 eggs. Dr. Crowell's remarks before the Club about two weeks since were very true and in good time. To supply the increasing demand for eggs, many parties have sent out eggs that were not impregnated. There is no excuse for this, as the difference is very plain after fifteen days. The doctor says he got beat buying eggs; so did I, but by another party. The nearer the eggs are to hatching, the better they bear transportation, but it is perfectly safe to send eggs when thirty days old if properly packed, the form of the young fish can then be seen, and there is no excuse for putting in bad ones. There is an increasing interest in fish culture, which I am glad to see, and I should like to see our fisheries commission encourage those so engaged by visiting or corresponding with them in regard to the conditions of the streams or waters in their locality. The commission has done much during the past year, but they have labored on the Hudson river mostly, and the fishermen have seen a great increase in the stock during the past season. Our county agricultural societies might do much to encourage it. Through this section of the State there are many chances to start, with every chance of success, as all of these northern counties have fine springs and gravels now filled with trout to stock with.

WINTERING CABBAGES.

Mr. P. T. Quinn.—It will add very much to the pleasure, as well as the profit, of every farmer, no matter what extent of surface he cultivates, to have at this season, an abundant supply not only of potatoes, but also beets, carrots, parsnips, turnips and cabbages, to keep the table well supplied during the winter. He cannot be classed as a progressive, wide-awake farmer now, who neglects the kitchen garden, and from such neglect have but a scanty supply of only one or two kinds, instead of an abundance of all the leading kinds of vegetables for winter use.

The cellar of the dwelling-house is too often made the store-room for the stock of winter vegetables. This should be avoided whenever it is possible to do so. It is rarely that a quantity of any kind of vegetable is thrown into a heap but there is more or less decay, and the odor from such decaying vegetable matter soon taints the atmosphere of the house, making it unpleasant, and unwholesome to breathe. This is strikingly so with cabbages, a vegetable that will keep in better condition when carefully buried out of doors than when put in the cellar, besides we thus get rid of the unpleasant smell of decaying cabbage leaves.

Those who grow late cabbages for market purposes always bury them in the field until such time as they are wanted for market, in mid-winter or toward spring. At our farm we usually bury from 20,000 to 50,000 heads every year, and seldom lose, by rotting, anything worth mentioning. We begin to bury cabbages for winter use from the fifteenth to the twenty-fifth of November, being guided always by the weather. In case the weather is warm and pleasant along toward the middle of the month then the work is put off until a later day, while, on the contrary, with cold, frosty nights and no growth, the work of pulling the cabbages and placing them in "beds" is pushed forward with all possible haste. White frosts seldom do any injury to winter cabbages, but when the heads are left exposed to two or three successive nights of hard, black frosts the cabbages will not keep well, and will more than likely rot badly before spring. Therefore it is better to pull and bury the cabbages in the latitude of New York on or before the twenty-fifth of November, to be sure the outside leaves are not injured by frost.

When pulled and placed in "beds" heads down, they may be left so without covering with earth for two or three weeks without suffering any injury, provided the weather is warm and mild. In fact it would be better, under such circumstances, to leave the cabbages uncovered until such time as steady cold weather begins. We have now growing on our farm between 30,000 and 40,000 marketable cabbages. A large share of these will be cut and sold between now and the first of next month. We have always heretofore buried a part of our crop, anticipating higher prices in mid-winter and toward spring. Some seasons we make a hit by so doing, and again have to sell in the winter for the same prices that we might have in the fall, and have nothing for the labor and expense of burying the cabbages. We have found from keeping an accurate account of the labor of burying, that it will pay even better to sell cabbages at eighty dollars per 1,000 in the fall than winter them and get $100 per 1,000. Of course there is always more or less from rotting, and when this per centage of waste is deducted, and the labor, it may safely be set down from one dollar and fifty cents to two dollars per 100. It is not unusual for cabbages to advance on fall prices during the winter two dollars, three dollars, and four dollars per 100. The point that I wish to illustrate is that with an advance of only two dollars per 100 above the fall prices there is nothing gained by the grower.

When the proper time arrives for gathering the crop, each man is provided with a stick about three feet long, and one and one-fourth inches in diameter. This stick is carried in the right hand, and is used in pulling the cabbage as a pry, and when the cabbage head is turned upside down, for knocking the earth from the roots. Beginning at one side of the field, every man takes two rows of cabbages. The cabbages are sorted at the time of pulling into two sizes. The large solid heads are thrown into one line, while the second size, or small, hard heads, are thrown by themselves into another. This plan we find to work better than when the large and small heads are bedded together. It sometimes happens in the winter that a customer wants a load of large or one of small, and when they are in separate beds there is no trouble in getting out at the time just what is wanted.

When the cabbages are all pulled, then a suitable spot or ridge is chosen to make the bed, or a continuous line of beds across or the length of the patch. A narrow strip of eight feet wide of ground that is a little higher than the adjoining surface is preferable for the purpose. The cabbages from either side for a distance of ten or twelve feet are carried to this chosen line, and one man places the heads close together, heads down and roots up. We make these beds eight feet wide, and such length as to save time in carrying the cabbages unnecessary distances.

Sometimes a bed is forty feet long, then a vacant space of the same length, and then another bed of twenty-five or thirty feet, and so on from one end of the lot to the other. The principal object is to have the outside lines of the row of beds straight, which will make it very much easier work in putting on the covering of earth. The second sized heads may be placed in the same row, but in separate beds. When cabbages have done well there will not be more than a fifth of the crop that will come under the second size, but it often happens that one-half or a third are small, and of course the beds of large and small will be alternate. Three active men will pull and place properly in beds 12,000 cabbages in a working day of nine hours, and with a pair of horses and a plow the same number of men will cover 20,000 in a day. This I have had done frequently where the cabbages headed uniformly, with but few missed or not headed in the patch.

When the beds are all laid, then, with a plow and two horses, three furrows are turned toward the line of beds on either side. The first furrow slice is turned close to the cabbages, covering them if possible. By means of shovels the loose earth on either side is thrown over the cabbages, covering all the heads and an inch or so of each stock. When the bed is finished there should be nothing visible, unless the roots and part of the stocks. The less quantity of soil that is used to do this the better, for cabbages will keep longer and in better condition with only two than four inches in thickness of soil as a covering. The more depth of soil put on, beyond the amount necessary to cover the leaves, will make it so much more difficult in taking them out in the winter when wanted for use.

Many cabbage growers still practice placing the cabbages close together, heads down, in single rows, and then turning a furrow slice from either side toward the cabbages. When the plow fails to cover all the heads, the work is finished with hand hoes.

The first method I like best, from the fact that the cabbages keep equally well, and when the ground is frozen hard in winter, one man will take out more cabbages from the beds than two men will from single rows. In the beds, by making two or three openings with a pick-ax, the covering comes off in large flakes at a time, without much hard work, while with single rows the covering of soil is removed in small pieces, taking out only a single head at a time. This would only be objectionable if cabbages are to be marketed during the winter, when the ground is frozen. In the spring, when the frost leaves the ground, the heads can be easily pulled from either beds or single rows. In the kitchen garden either method may be adopted, and with care in putting the heads in place the cabbages can be kept for family use until the first of the following May. The curled-leaved varieties of Savoy will keep better when "heeled in," with the heads up. This variety of cabbage will boil more tender when kept in this way than when the heads are turned, although it keeps very well when protected the same as other winter varieties of cabbages.

Those who are fond of cabbage-greens in the spring, can have plenty of such by saving the stocks and heeling them in when the cabbages have been cut off during the fall. In the spring these stocks are taken from their winter quarters and planted out in some nook or corner of the garden, and very soon young cabbage sprouts may be gathered in abundance, before spring vegetables are ripe. German gardeners often practice this plan of saving the stocks and transplanting them in the field in the spring, to raise cabbage sprouts for market.

Adjourned.

November 29, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

THE PRESERVATION OF PORK.

Questions touching this subject were asked by Mr. L. H. Albertson Jr., Delaware Station, N. J., who thought much might depend on "promoting a dry state of the meat," and that the manner of bringing about this result might be a topic worthy the consideration of the chemist.

Prof. J. A. Whitney replied that there is no practicable mode of keeping fat meat by drying. The chemical changes that make fat rancid are quite different from those that render red meat or muscle unfit for use. The latter may, in some countries, be cured by drying in the open air; this is the way that the jerked meat of South America is prepared, but the plan answers only in very clear, dry climates. Mr. Albertson had better salt down his pork in the good old-fashioned manner in a clean barrel and rest content.

COTTON-SEED MEAL

Mr. T. H. Bedell, Poughkeepsie, N. Y., desired to know: First. Is the cotton-seed meal of commerce simply the seed ground, or is it the meal of the cake after the oil is expressed? Second. What is its value for milch cows in comparison with other grain? Third. Where can it be obtained?

Prof. J. A. Whitney.—The cotton-seed has three portions, the kernel, the hull, and the fibers that cling to the hull after the seed comes from the gin. This fibrous material should be taken off by machinery; it would make better paper stock than rags, and it is estimated that the annual product would be about a quarter of a million tons. The hull should be taken from the seed before grinding, this being the most approved practice. The grinding and pressing extract the oil which is much too valuable to permit the unpressed meal to be used for feed. The cake, ground, makes a most valuable feed and should be used in this country for cattle just as linseed cake is in England. The benefit is obtained not only in the growth and fattening of the cattle, but in the greatly improved quality of the manure, a point not sufficiently appreciated by our farmers. English chemists have very minutely investigated the relative value of different kinds of food, and of the manure derived from them. I will prepare for a future meeting a brief abstract of the results as stated by them, having more special reference to linseed cake and cotton-seed meal.

Prof. H. E. Colton.— Cotton-seed meal is simply the cake ground fine. Its value as a food for cows is greater than any food except corn meal, while it is cheaper than any of the grain meals. It should be fed mixed with hay, just as has been the custom to use linseed cake meal or corn meal. The production of this article is likely to be very large this season. There is a large crop of cotton, hence plenty of seed, and many new mills have been erected. There is still room for many more, as the uses of the cake and the oil are both becoming more varied and the consumption greater. Any commission merchant will furnish it to the gentleman on his order. I would advise buying the cake and grinding it himself. Any common corn-mill will do. During my trip south I talked to the planters of this article and found that nearly all of them were going to try it as a manure; that some had, with very good effect. They generally use it mixed with ground phosphates or super-phosphates; some add plaster and a little salt. As a cattle food I was told it added great richness to the milk. Large quantities of it are exported to Europe, and the English farmers use it both as a feed and fertilizer. If they can afford to pay forty-five and fifty dollars gold, per ton for this cake, our farmers certainly can afford to pay thirty-five to forty dollars currency. At a rough estimate I would say that about 100,000 tons of this cake will be made this year and about 4,000,000 gallons of the oil. The oil is clarified and used as a salad oil; is also used for making a lubricating oil and for making soaps. For this last purpose it is especially adapted. I have seen some very fine Castile soaps made from it. As an industry at the south it is destined to be a great and profitable one. It enables the farmer to add several dollars to the bale on the price of his cotton, and gives to the world a new article of commerce from that heretofore wasted.

Mr. J. B. Lyman.—It has been proved, I believe, that the droppings of cattle fed on oil cake are just as valuable for manure as if the cake itself be applied directly to the soil. The phosphoric acid, which is the precious thing in agriculture, is used by the animal in very small quantities, and the most of it, rejected in the excreta, adds greatly to the value of the manure.

Dr. J. V. C. Smith.—I would speak against the use of concentrated foods either for man or beast. The stomach must have the stimulus of distention.

Mr. F. D. Curtis.—Of course cotton-seed cake and similar substances must be given in connection with something bulky, and it might be timely to talk now, or at the next meeting, on this phase of the subject.

Mr. John Crane.—I have had experience in feeding cotton-seed meal. Last year I used a ton of it and received great benefit. I mixed it with buckwheat bran. How it might answer for horses I am not informed. I have seen it stated that there are objections. Perhaps Mr. Curtis will speak also of this matter.

Improved Methods and Remarkable Crops.

A few weeks since a committee consisting of Dr. Trimble, Chairman Ely and Dr. Smith, went on a tour of observation among some pattern farmers south and west of the city of Philadelphia. As notes of what was seen on the lower Delaware, Dr. T. read the following paper:

The present report is intended to give a brief account of some novelties in agriculture that we met with near Salem, New Jersey. The corn and potatoes on the table have been sent to the Club at the request of the committee. The potatoes are the peachblows, there are eleven, weighing ten pounds. They are nothing remarkable, either for quality or size, but as the result of an experiment in cultivation they may be of much interest to potato growers. The ground upon which they grew had been in with corn the year previous, and was not plowed at all for the potato crop. The seed potatoes were covered with earth just two inches deep, and then the ground covered all over with coarse hay to the depth, while loose, of about a foot. This hay, of course, was soon packed so as to be only a few inches in depth, but still sufficient to prevent the growth of all weeds or grass; but very little manure was applied. From some cause the potatoes did not come up well, and the stand was poor; but still the crop was 300 bushels to the acre. The crop on land adjoining, cultivated in the ordinary way and heavily manured, was only half as good, or 150 bushels to the acre. This experiment was made by Clark Thompson, who told us that on two previous seasons he has had as much as 600 bushels of potatoes to the acre by this mode of cultivation. To know how to grow such crops of potatoes without the plow or cultivator, or the hoe, and still have no weeds, would certainly be valuable knowledge to all who can have the material for such mulching. The farmers who have banked out the tides and converted mud into meadows, have an abundance of such hay. Many others have low grounds or swamps that would produce coarse grass of little value as hay. Mr. Thompson next took us to his corn-field. We found it like nearly all others in this celebrated corn region, more like a cedar swamp than ordinary corn-fields. Stalks ten, twelve, fourteen or even sixteen feet high; ears like these, a foot long and seven inches in circumference, and many of them so high up as to require the stalks to be bent over to reach them. Often two to a stalk. The ground on which this corn grew was a meadow, and had been in grass the year before. It had been plowed in September last year.

Mr Thompson told us he had given orders to go just one inch deep but it seemed impossible to gauge the plow to such shallow work. He was just plowing an adjoining piece of ground for the next year's crop. This we visited also, and our chairman made numerous measurements, and while the sods were mere shavings as compared with ordinary plowing, we found the average deeper than an inch, probably from one and one-half to two inches, but not more. This sod is torn to pieces with the harrow before planting in the spring, and is truly a coating of vegetable mold. Mr Thompson's corn crop of this year was, of course satisfactory, or he would not prepare the ground in the same way for the next one. Clark Thompson is one of those Salem county farmers who has been reported to be much opposed to subsoiling, and we asked him the question "Yes," says he, "I would not permit any one to subsoil my land for fifty dollars an acre. We asked why? "I believe in manuring, and I want that manure where the roots of my crops go, and I do not want the stiff subsoil made so porous that the strength of that manure will leach down where the roots do not go."

The three thick ears of corn are from David Petit. Two of them have 1,300 grains each, the other about 1,400 or thirty-two rows, with forty-four grains in a row. It is ten inches long by nine inches in circumference. The cob is seven inches in circumference. The ear weighs one and one-half pounds. It is a rule that seventy pounds of corn in the ear make a bushel; at that rate forty-seven such ears would make a bushel of shelled corn, or less than half the number usually allowed. Friend Petit writes us that he does not send this corn to be advertised; he has none to sell. The five weeks of hot weather without any rain between harvest and the 10th of August, prevented this corn from filling out to its full length; that most of the longest ears have more or less of the cob unfilled, owing to the season. In some seasons he has had ears with 2,000 grains, and each ear would shell a quart or thirty-two ears to the bushel.

He hopes for such a season again. This corn is the result of an experiment continued for many years. He originally begun with nubbins, or deformed ears taking only those for seed that were unnaturally thick, from the idea that if he could retain the thickness he could increase the length; and he has certainly succeeded to a great extent. The following is an account of his mode of cultivation: Where this corn grew this summer, wheat is now sown. Clover-seed will be sown in the spring. That clover, judging from a great number of fields we saw where wheat had been harvested this year, will be a rank growth by next fall, and be plowed under the next spring just three inches deep, and planted with corn. Thus, while he has either wheat or corn every year on the same ground, he has an intermediate crop of clover which is the chief fertilizer of the corn crop. He further says, "by thus having such a large amount of vegetable matter near the surface, the crop is able to withstand a great amount of dry weather, as the moisture cannot escape from below without coming in contact with this vegetable matter at the surface, which is one of the best materials for holding moisture, and will hold it for the benefit of the growing crop. The change in the soil in this respect, in my corn lot, which you saw when here, is really wonderful, so much more loose and moist. Two years before, in dry times, it was a stiff clay, very liable to bake. But this plowing-under of a heavy crop of clover has rendered it pervious and mellow the whole summer. I never saw so great a change for the better in so short a time in all my experience in farming." "This," says friend Petit "is a movement in the right direction; but to get the full benefit, the vegetable matter must be kept near the surface."

As to the crops in this part of New Jersey, the corn, though seriously affected by the five weeks' drouth after harvest, would probably reach the usual average of sixty-nine shelled bushels to the acre, many fields much overrunning that amount. One farmer reports ninety bushels. The wheat had not been an average; the heavy rains and hot weather of May and June were unfavorable. The crop of sweet potatoes was almost unprecedented, the hot summer just suiting. On the contrary, the round or Irish potato was not more than half a crop. Many farmers in other parts of the country will be surprised that land so constantly cropped with grain should so steadily increase in productiveness, but it must be remembered that marl is abundant and most freely used; indeed, everywhere in south and west Jersey we saw great heaps of marl all along the railroads, not only at the stations, but at the common roads and farms. The 15,000 acres of dyked meadows also tell upon the uplands of all the farmers who are fortunate enough to be part owners. They are inexhaustibly fertile. The hay made from them feeds the stock of the farm, and the manure goes to the uplands. All farmers cannot live near tide-water rivers, but many have undrained swamps that could be made to produce their hay, and thus be made to restore the exhausted fields. Your committee found it refreshing to meet with such farmers and to see such farms.

The Chairman.—I think the report should not have ended without mention of the handsome way in which David Petit and Richard Acton treated us. Of course, good, pious Quakers as they are, they gave us no liquid refreshments stronger than tea and coffee, and we wanted nothing more. For my part, when I hear sneers at farmers, that they are rough and dull, that their boots smell of the cow-stable, and their talk is never higher than the horns of their oxen, I wish such carpers would go down there to a neighborhood that has been rustic and only rustic from the days of George Fox and William Penn, and see how intelligent, how wise, how refined and courteous, the most practical and money-making farmers can be.

GRASSES AND CHEESE IN THE HIGH LANDS OF THE SOUTH.

Mr. F. D. Curtis.—I wish to refer to the specimen of cheese from western North Carolina, cut in the Club two weeks ago. I was one of a large committee who tasted it, and I carried a piece of it some days, and asked several good judges to taste of it. All pronounced it excellent cheese, superior to the average of northern factory make, and some in particular praised its sharp flavor. The fact that cheese of excellent quality is made so far south, is, to my mind, a very interesting one. It may add many thousand acres to the area from which good cheese may be expected, and it shows that southern farmers can with profit enter upon diversified industry and become independent of the north in the great items of dairy products, if they will but use all their lands that are adapted to grass.

The Secretary.—I was also of the committee; the sample I had was shown to an old grocer who formerly dealt largely in the article; he highly approved of the quality and said all it required was age.

Mr. J. B. Lyman.—I have just returned from a visit to that region and to the Elk mountain dairy. I find that there are a number of mountains between the Alleghany and Blue Ridge sierras, that rise from 3,000 to 6,000 feet above the sea. They are different in appearance and in their geological history from the ranges. There is Elk mountain, five miles from Ashville, and Craggy mountain, twelve miles distant; then, further north, Mount Mitchell and Black mountain, and Mount Guiot and Roan mountain. These are composed of granite, in which there is a vast deal of mica and also of feldspar. The grinding down and melting away of this mica-bearing granite has produced a soil rich in potash and particularly adapted to grasses. At Elk mountain I found 1,200 acres cleared and set in tame grasses. Clover, timothy and orchard grass have all been sown with excellent results. Mr. Cornell has cut two tons from an acre and over, beside a fine pasture all the fall. He has 120 acres of orchard grass, and says he prefers it to timothy or clover to make cheese with. He makes a pound of cheese with six pounds of milk when the cows are on the orchard pasture, while he uses seven or eight pounds of milk for one of cheese when the cows are in clover or on timothy. He finds orchard earlier in the spring, and it stands frost better and gives a better bite under a light fall of snow. He has made 24,000 pounds this year and sold all at twenty cents on the shelf in the dry room, and could sell three times as much if he had it.

The high mountain lands are difficult of access, and covered with heavy timber. On Elk mountain they are worth from five to ten dollars; on remoter peaks they can be bought for one dollar. The estimate is that it costs twenty dollars an acre to fence, clear and seed down. I judge that sixty cords to an acre would be an average. The growth is white oak, poplar, hickory and some very large chestnut. The soil on the north side of these mountains is the best, and that on the very summit is equal to any. The climate is dry, uniform and the most healthful on the continent. Ice in the winter forms about two inches thick. One needs a blanket every night in July. I saw his mercury table for August last. It ran seventy degrees with great uniformity, going to eighty degrees only twice at noon, and falling below seventy degrees before bed-time. He says he had but one floating curd this summer, while in a factory at the foot of the mountain they had the mercury over eighty degrees, and floating curds all through August. Of these good dairy lands I judge there are at least 20,000 acres, within from five to twenty miles of Ashville, and it can be bought in forest at from one to ten dollars, according to remoteness and roads.

They are rather high and cool for corn; but oats, barley and all the root crops are very large. He showed me a potato field that yielded at the rate of 400 bushels per acre. He has no difficulty in growing 800 bushels of turnips or mangolds without manure. I believe the time is near when those high mountain regions, so admirably adapted to persons with chest complaints, will be dotted with cow-stables and cheese-factories, and with hundreds of farm-houses, the church, the school-house, and the steam mill figuring in every landscape.

LABOR-SAVING IMPLEMENTS.

Mr. P. T. Quinn.—It has frequently been stated by agricultural lecturers, and the statement found its way into print, that, with good management on the part of the farmer, and by adopting the improved labor-saving implements, a bushel of grain or of roots can be produced as cheaply as they can in Europe, where labor is a drug and labor-saving implements are not in general use.

The gravest obstacle that American farmers and gardeners have now to contend against is the labor question. Farm labor is high-priced, and the bulk of it of a very indifferent quality. The different trades or branches of manufacture require of their operatives a specified term of apprenticeship before they can be employed as journeymen and receive full wages for their time. This is not the case or custom with the kind of labor employed on the farm. When a young man is endowed with physical strength, and can use the spade or shovel, without any further knowledge of farm work or implements, he starts out as a finished journeyman, and demands for his services the highest wages. This condition of things is more common among us than anywhere else, from the fact that, when intelligence and industry are combined in farm help, such help in a few years will start farming on their own hook, and their places have to be filled by raw and untrained recruits, who at first know little or nothing of the labor or proper use of farm implements.

There is one practical remedy within the reach of every farmer and gardener in the country, and they will have to come to it sooner or later; and that is, a more general use of labor-saving implements on the farm and garden. Land is plenty; manure, in most sections, can be manufactured at home or bought at reasonable rates, and the demand and prices for farm produce have been, for the past ten years, exceptionally good, and there is no reason to suppose but what both good demand and fair prices for farm produce will continue in the future as they have in the past ten years. Every practical farmer who employs help to carry on his business will tell the same story; that his labor account cuts down his profits an unjust proportion. This will continue so until such time as farm machinery is made available and practically applied to lessen the expense of hand-labor in preparing the ground, planting, cultivating, and harvesting the crops.

It is now, and always has been, a difficult matter for some farmers to divert their course or change their methods of doing their work from the well-worn "ruts" which they have traveled through without interruption for twenty or thirty years in succession.

When the mowing-machine was first introduced, it was asserted that its use on the farm could not become general, because most of the meadows were too rough and uneven on the surface to cut the grass with the machine. However true this might have been then, it is not the case now, for every piece of land laid down intended for permanent meadow the surface of the ground is made level at the time of sowing the seed, and any stones or other obstructions that might hinder the use of the machine removed.

It is only a few years ago that I was told by an intelligent German gardener that, to be successful with growing cabbages, the hand hoe was the only tool that could be used, and it would ruin a crop of beets, carrots, turnips, or parsnips, to cultivate with a horse tool while the plants were small; the loose earth thrown from either side of the tool would cover up the plants, etc., etc. These difficulties are easily overcome by leaving more space between the rows, and for delicate plants, like carrots, sowing the seed on drills instead of on the level, and by this means doing nearly all the cultivation with horse instead of hand labor.

This season we planted one acre of carrots in one field. Before planting, the ground was plowed three times, and well manured. The seed came up well, except eight rows, where enough of seed was not used. The cultivation between the rows was all done by a mule and carrot-weeder. This tool was run twice in each row, about once in every two weeks, from the 15th of July until the 1st of September. The thinning the carrots and pulling the weeds that grew in the rows, cost $28.50. On November 5, at eight o'clock A. M., we commenced to get this acre of carrots out. We had four men, a pair of horses and a Mapes' lifting subsoil plow. The plow was run alongside of each row, and this took the team and the two men until noon to do it, one man holding the plow and the other to drive. This plowing loosened the ground so that the carrots pulled easily. In pulling, three or four rows were thrown together, placing the roots all one way. This plan lessened the work of topping one-third at least, if not more. At four o'clock on the same day the carrots were all pulled, and the rows arranged as stated. The four men then commenced to top the carrots, and at three o'clock on Saturday finished the job, doing all the work in a day and three-quarters, at a total of $9.50. The crop was of an average; the acre yielded 501 bushels, and, as will be seen, cost less than two cents a bushel for getting them out and topping. To dig and top the same number of bushels of carrots in the old-fashioned way would cost, at the lowest estimate, three times as much. Six cents a bushel is usually estimated the cost of digging and topping a bushel of carrots. I mention all the particulars in this case to show the advantages of a more general use of improved labor saving implements in trucking as well as in general farming; and until such tools are more generally used the lowest cost of producing a bushel of potatoes or carrots cannot be estimated.

The subsoil plow that was used in getting out those carrots we have had on the farm now ten years, and have used it some every year since. The first cost of the plow was thirteen dollars, and in half a day's work, loosening carrots, the amount saved was more than the amount paid for the plow ten years ago.

Adjourned.

December 6, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Timber.

Mr. G. W. Adair, Madison, Ga., wrote to say that, in the southwestern portion of his State, and along the Oconee river, and on the Brunswick railroad, are millions of acres of pine which can be bought at from one dollar to two dollars per acre, and that persons in pursuit of cheap woodlands would do well to make a note of the fact.

Dr. Isaac P. Trimble.—The trees are certainly very fine; a large portion of them two feet in diameter; and when cut off, the land is readily prepared for farming purposes. These facts I remarked when I traveled in that section; but it also occurred to me that the facilities of transportation are as yet too few to enable one to sell the timber readily.

Mr. J. B. Lyman.—Profit from handling timber all hinges on the question of freights. Ten thousand settlers are burning in their cabins, in Georgia and the Carolinas, pines which would sell at four cents a foot for flooring in any of the northern cities. But skilled labor is uncertain and high-priced; food is expensive, roads are muddy, mules costly; if a mill breaks, a casting must be sent 500 miles for repair. All these circumstances devour the profits. If Mr. Adair will show us a tract of 1,000 acres on a stream where the flooring can be laid upon a schooner and delivered north of Chesapeake bay for a cent a foot for freight, he will show a business in which there may be much money for a man that knows all about a saw-mill.

California and the Chinese.

When it was known that the Hon. George Barstow, of San Francisco, was in the audience, there was a desire expressed by several members that he take the stand. He did consent, and found good means to win applause. He said, in effect: I am glad to be here, because I see here a center and focus where is collected and thrown out information on subjects of which I am sorry to say I am deficient. I have listened here for twenty minutes, and I gather in this brief space of time that it is your practice to receive and sift, alchemist-like, the good from the bad. I trust we on the distant shore may avail ourselves of the benefit. We need it. We have 800 miles of sea-coast, along which there is a climate never too hot or too cold. We have valleys where it is easy to raise thirty bushels of wheat to the acre, and that of a quality, too, which eastern men are so fair as to pronounce equal, if not superior, in quality, to that from Genesee. We have, also, grapes of every variety, in the open air, which you raise with difficulty under glass. We have tropical fruits, too; and, with all these blessings, it is natural that we should grow a little vain and boastful. But it is true that we have need of much of the information which is imparted here.

It was mentioned by a member, that, while in San Francisco, he found Mr. Barstow at the head of a Sabbath-school where Chinamen were being educated, and he asked that gentleman to speak of the coolies and their character.

Mr. Barstow. — While I belong to that class of persons who do not wish to see our country deluged with Chinese, I at the same time think, since we have invited them, the best thing we can do is to endeavor to imbue them with the ideas of Christian civilization. The Hon. Eugene Casserly, who has had opportunity to judge, speaks of the Chinaman as skillful, apt, docile, quick, temperate, and laborious. My observation and experience seem to justify this estimate. The normal condition of the Chinese as a nation is industry.

Mr. J. B. Lyman.—If Chinamen are employed on farms, will they become restless, and want to change?

Mr. Barstow.—The Chinaman is accustomed by tradition to fulfill his contracts faithfully, and so far as I know he lives up to this custom of tradition. He remains for the season, having been brought up to long periods of service.

Mr. H. L. Reade.—Suppose forty farmers in Westchester county conclude next spring to employ Chinese labor, how shall they proceed?

Mr. Barstow.—They must correspond with agents in California. As is well known the Chinamen prefer to work in gangs, and they require an interpreter.

Mr. John Disturnell.—Do we understand that you wish coolie labor?

Mr. Barstow.—Exactly the reverse. We want, and it will be better for us to have, the German, the Swede, the Norwegian, the Irishman. I do not wish any additional encouragement given to the Chinese than the treaty gives them. We do not want him in California, but so long as he accepts our invitation and comes, we shall do what we can to civilize him.

Mr. A. S. Fuller.—What we need are men willing to work, and I don't care what their nationality may be. The trouble now is people won't work, but like to make a living in some other way. I am in favor of Chinese, just as I am in favor of engines or water-power.

Texas, its Fertility, its Railways, and its Beeves.

The Chairman.—I am pleased to introduce to the Club a gentleman of distinction from Texas. He is, I believe, a member of her Legislature, and he is in New York negotiating the finances of railroads that may connect that vast and fertile State with this metropolis. I refer to Gen. W. H. Parsons of Houston.

Gen Parsons.—In some hints that were thrown out by one of your members, Mr. Chairman, I perceive a gleam of that old prejudice which I fondly hope will, month by month, dwindle and at last wholly die out from the hearts of men. Something was said of those sunny lands as being unfit for the homes of white men. I am aware of the taste which you of New York display for the azure eye, the alabaster skin, and golden tresses. Well, that is a northern taste, and you have reason to be proud of your beautiful blondes; but for me, I love the dark and melting eye of the balmy land, the mellow and passionate beauties of my own sunny south. But, Mr. Chairman, my object in visiting your metropolis is to assist in the nuptials between the mellow and voluptuous heiress of the land of the orange and citron, with the vigorous manhood an stalwart energy of the Titan of the north. In other words we of Texas are laboring for direct and air-line railways to connect us with this thundering metropolis, this mighty and throbbing heart of America. We feel that, far to the south-west as we are, our beauties and our riches have not been appreciated as they should have been. You have not sent out your Joshua, son of Nun, and your Caleb, son of Jephunneh, the tall and sightly men of your society, to penetrate into our "far countree" and bring back good report. We promise you, when your Joshua comes we will take him to the brook Eschol, on the yon side of the river, where he will find clusters that shall touch the ground as two bear them on a staff between them. The gentleman from California has referred to his 700 miles of coast. Mr. Chairman we have 800 miles of coast. Our land is fertile and productive throughout its whole extent. We are as large as the whole kingdom of France. France supports a population of 40,000,000; we have by the census just taken, as Gen. Grant told me the other day, a total of only 1,500,000. Yet the past year we made of cotton alone $34,000,000 worth. Yes, we want 30,000,000 souls in our State. There is room for all and land for all, and work and wealth and joy for vast congregations of humanity on those broad emerald oceans, those flower-enameled savannahs of my beautiful and balmy land. To give you an instance of the ease with which a competency is won a citizen of yours last season penetrated to the inland county of Hill, 300 miles from the nearest boundary of the State. Arriving there with only his scrip and staff, with energy, but without money, he agreed to buy 640 acres of prairie and took possession of it, bought a plow, hired a mule, and went to work. In the fall he had cotton to sell valued at $1,500. He bought his square township with that money and has to day as fair and fertile a homestead as you will find in a ride of a thousand miles. What he has done others can do.

Your country is full of men who show amazing, but I think a misdirected energy, in pounding out a grim livelihood among the rocks and snows and sands, when one year's labor will give you the domain of an English nobleman, on a soil richer than any the sun of England shines upon.

Mr. J. B. Lyman.—If the gentleman will allow the question, we would be glad to know somewhat more of the beef-producing power of his State. Our associations with the mention of your State are of roasts and sirloins, of hides and tallow. What can you say of Texas live stock?

Gen. Parsons.—I thank the gentleman for the hint, and, to answer his question direct, I will say there are 8,000,000 of neat stock in this country and five of those 8,000,000 are grazing on the prairies of Texas. In Houston I can buy a quarter of beef for one dollar. In Galveston, a city of 35,000, the choice cuts of a steer are sold at ten cents a pound. The gentleman from California has spoken of the wheat of his State. Sir, if he can bread the American people, Texas can *meat* them. Mr. Chairman, I did not mean to run into that play upon the word; but, since it has passed my lips, I will repeat, that we can meat this metropolis, and shall be most happy to meet this metropolis. I walk through your markets, and I note the figures at your stalls, and I see with pain that fresh beef is fast becoming a luxury with you, an indulgence that your opulent and prosperous can indulge in, but which your artizan, your seamstress, and your laborer cannot afford. Your workingmen cannot afford to give thirty cents for a cut of round. Yet I am sorry to say that, in large regions of my State, over a territory as big as the State of New Jersey, Texans are killing the beeves for their hides and tallow. Nay, in some towns they are cutting up bullocks and throwing flesh, horns, skin, tallow and bones into great vats, boiling them down for the tallow, and grinding the scraps for manure. So, you are actually throwing out as garbage and dung upon your gardens good, wholesome meat, and all because Texas, the beef-producer, is so far from New York, the beef-consumer. You want our cotton, and you get it, but you want our beef more. Man shall not live by bread alone. I fancy that Adam ate the fig long before he plucked the fig-leaf to hide his nakedness. The clamor of the stomach is far sharper than the outcry of the back. There is more food in our prairie State than there is of gold in the hills of California or coal in the mountains of Pennsylvania; and Texas, your once wayward sister, but now repentant and content with her sisterhood, may prove to be the Cinderella on whose princess-foot the slipper of fortune shall at last be found.

Asbestus Roofing.

The committee appointed to examine the asbestos roofing made by Mr. H. W. Johns, of New York city, would report that such examination has been made, and a full verbal account received of the process of manufacture.

The product may be described as consisting of a stout canvas web, having on one side a strong backing of Manilla paper, and on the other a thick felt-like coating formed of a mixture of prepared coal-tar and asbestos ground into a kind of flock. The preparation of the coal-tar merits especial notice, as by it the objectionable properties of the ordinary article appear to be avoided. The crude tar is subjected to distillation, which eliminates the dead oil, so termed, and the lighter or volatile oils. The latter are then mixed with the heavy residue left in the retort, and the compound is mingled with the ground asbestos. The light oils evaporate, leaving the thick material upon the fabric, and forming a tough, slightly elastic, and water-proof coating. The fabric is put up in rolls for transport, and is very readily unwound and nailed in its place on the roof-boards. This done, it is coated with a paint made of materials identical with those of the coating, previously described, on the felt. In a short time the paint hardens, and the roof is complete.

Whether the roof thus made has the durability of tin, costing several times as much, as claimed by the manufacturer, can only be proved by actual trial; but your committee, reasoning *a priori*, believe that, from the peculiar method employed of preparing the coal-tar, the tough, fibrous and indestructible nature of the asbestos mingled with it, and the care evidently shown in the several stages of manufacture, believe that the material constitutes, for a cheap roofing, one of unusual merit, much superior to any of the class previously brought to their notice, and worthy of trial by those who desire a durable, easily applied, comparatively inexpensive and safe roofing, the material having, in addition to the other merits claimed for it, that of being practically fire-proof, and consequently much less liable than the shingles commonly used on barns and rural dwellings to catch fire from flying sparks, etc.

JAMES A. WHITNEY,
JOS. B. LYMAN.

RED-FLESHED AND WHITE-FLESHED TROUT.

Mr. Clift, of the Poheganut Trout Ponds, Mystic Bridge, Conn.—I notice the opinion of Mr. A. R. Fuller, in your last Club report, that white and red-fleshed trout are the same article. Pisciculturists differ upon this point, and no satisfactory conclusion has yet been reached. As it is a matter of much practical importance to the mass of your readers who have trout brooks and are beginning to stock them, I wish to present the evidence of the other side of the question. It is my belief that the red-fleshed trout is not a distinct species from the white, but a distinct *breed*, marked with permanent qualities that will be perpetuated for several generations—just as the Short-horn is a distinct breed from the Ayrshire. The best sustained theory of the origin of the red-fleshed breed of trout is that their good qualities are made permanent by feeding and breeding in tide-water streams, or brooks that have uninterrupted communication with the sea. They have a much greater variety of food than the trout bred in mountain streams. This food consists mainly of shrimp, smelt, and the young fry of the anadromous fishes that come into fresh-water streams to spawn. The food is of richer quality, is more abundant, and imparts its flavor and a darker color to the flesh of the trout. As a matter of fact, these shore-stream, red-fleshed trout grow much more rapidly, are a larger and stronger fish, and most people would say of better flavor. Some shore-streams on which there are no dams are famous for these red-fleshed trout. No other kind are found in them. Other shore-streams, obstructed by dams, have both kinds. In the upper section the white flesh prevails, and in the lower, the red; though the white and the crosses of the two varieties are found in the lower waters occasionally. Those which have been confined to the lower waters continue of the highest color. Those which have been cut off from the sea for generations grow pale until they are as light colored as the mountain trout. That the red-fleshed are the larger and stronger fish is a fact generally recognized. In the last report of the Massachusetts Fish Commissioners, the details of an experiment with the spawn of the white and red-fleshed trout are given. "Most of the trout were hatched from the spawn of the small, white-meated, New Hampshire trout. But there were also a few of the fine red-fleshed Cape Cod trout, and these were perfectly distinct by their darker color and more robust form. In fact, there was very much more difference between these two varieties than between the true and the land-locked salmon." Thus early in life the difference between the two varieties is clearly marked. It is a well-known fact that nearly all the trout caught in the small mountain streams in Vermont and New Hampshire are of the white-fleshed variety, and are very small, not weighing more than two or three ounces. In many days' fishing in Berkshire county, Mass., I do not remember ever to have taken a trout more than four inches long, but hundreds smaller. In almost any of the Connecticut trout streams emptying into Long Island sound, and in the Cape Cod streams, trout are ordinarily taken weighing from a quarter to a pound, and two and three pound trout are occasionally landed by expert fishermen, who know just where they lie. These fish are almost all red-fleshed trout.

In the ten or more miles of trout streams controlled by the Poquonnoc Fish Company, and in all the brooks of the vicinity, the most of the trout are of the red-fleshed variety, and are strong enough to cope with the pickerel. It is a common opinion, and the books tell us, that the trout will not live with the pickerel. But, as a matter of fact, these red-fleshed trout have lived with the pickerel, and maintained their ascendency for many generations. In fishing through the ice for breeding trout last winter in Poheganut Pond, seventy fine large trout were captured, and only two pickerel, which perhaps shows the relative numbers of the fish in the water. Looking at these facts, I come to the conclusion that the red-fleshed trout is a distinct breed, larger and fiercer than the white, and even if of no better quality, is better worth preserving add propagating. Epicures who have studied the matter insist upon the superior quality of the flesh. Perhaps friend Fuller would be of that mind if he had followed a shore-stream all day and dined upon the speckled beauties taken from his own basket. If we are to propagate trout, let us take the best, that are capable of fighting their own battles and eating pickerel. The survival of the fittest is a good maxim in pisciculture.

Mr. A. R. Fuller refers to Mr. Cliff's ideas about red flesh in trout being always the result of access to tide-water, and to disprove it adds: The highest colored red-fleshed trout I have ever seen are caught in the outlet of Meacham Lake, about twenty-five miles south from Malone, several hundred miles from the sea. While we catch all red-fleshed trout in the outlet, we get about an equal number of red and light-fleshed trout in the lake. October, 1869, I visited the spawning-beds down the outlet, and packed about 15,000 eggs of the red-fleshed trout, which I brought home and hatched in our hatching-house. The color of the egg was full as red as the flesh of the trout. During the spring and summer of 1870 I caught and brought to our ponds about 600 of these red-meated trout.

Planting Potato Sprouts.

Mr. M. G. Devoe, Owasco, N. Y., communicates the following experiments made by Mr. Guilbert Strang: I had about a quart of Early Rose potatoes given to me last spring. I had heard of such prodigious yields from a small amount of seed, I concluded there must be some deviation from the ordinary mode of planting, and I concluded to try an experiment. I let the sprouts grow on my potatoes until about the 1st of June. They were six or eight inches long. I then broke them off and set them out as I would cabbage plants. I put them in rows two feet apart one way and eight inches the other. I also cut the potatoes and planted them in the same way, in rows adjoining my sprout rows; and now, in digging my potatoes, I find my sprout seed to yield in every particular equal to that from the seed potato. Let them sprout to the length of six or eight inches; break off the sprouts and set them out as you would cabbage or tomato plants. Feed or eat up the potatoes, and nothing will be lost.

Adjourned.

December 13, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Ice Houses.

Mr. John Kershaw, Passaic, N. J., asked the question, and would also like to read a discussion, as to whether or not drainage and ventilation are important. Also, would a lining of tan bark be as good as one of sawdust.

The Chairman.—We have had the whole subject up time and again, and all the details have been printed more than once. However, we will be patient for the sake of new readers. I should say that wood is as much better than brick for this purpose, as it is cheaper.

Mr. F. D. Curtis.—Ventilation is not only necessary, but indispensable, where the temperature is warm. The principle is that heat rises, and that it must be carried off by a current of air. If drainage is neglected, of course water will accumulate and melt the ice.

Mr. William S. Carpenter.—While it is important to ventilate the space above the ice, it is equally important that no draft of air be permitted to come in contact with the ice itself. It is not always necessary to have ventilation at all. Sawdust is the best non-conductor. An inch is good; a foot better.

Cotton-seed Cake.

Messrs. Jewell & Ehlen, of New York, having noticed the discussion at a previous session, thought it might be interesting to exhibit specimens, so they sent decorticated seed, seed hulls, cake, meal, and seed ground for manure. They further said: The oil contained in the seed is valuable as food for farm stock; but for manure it is worth no more than a like weight of pine sawdust, and it is a discreditable waste of valuable oil, which is fully equal to that in corn for making fat hogs, mules, and horses, sheep and poultry, to use it as a fertilizer. True farm economy demands that a good share of this oil be transformed into fat bacon and hog's lard. Cotton seed meal gives nearly forty-four per cent of "flesh forming substances," or four times the amount found in corn meal. To manure land with cotton seed, as is done in many sections of the south, is very much like manuring it with wheat flour. Professor Le Conte, of South Carolina, states that "the oil in the seed contributes nothing to its efficacy as manure. On the contrary, it is rather a hindrance, since it retards decay and thus prevents the liberation of the valuable fertilizing properties of the hull. It is stated on good authority that fully two-thirds of every planter's crop is seed; that is, inasmuch as he sells his lint by weight, and as there are two pounds of seed to every one of lint, he really only sells and realizes on one-third of his whole crop. To show the loss to the planter from his inability to utilize his cotton-seed, if we take the average of 2,766,927 bales for each year, which, at 450 pounds to the bale and 2,000 pounds to the ton, gives 622,542 tons of cotton, with two pounds of seed to one of cotton, this estimate gives 1,245,086 tons of seed as the average yield of each year, half of which is kernel and half hulls, equal to 25,500,000 of bushels. Chemical analysis of the kernel has shown that it is richer in flesh producing elements than corn. As a substitute, therefore, for stock feeding, for corn, it is not unreasonable to place its value at an amount approximating to the price of corn on the plantation, say $1.25 per bushel. The analysis of the hulls contain from sixty to eighty per cent of fertilizing properties. Taking into consideration the price paid for the very large quantities of manipulative fertilizers now made by southern planters, and the absolute necessity in many sections for the use of some restorative to the exhausted lands, it is fair to put the value of the hulls at twenty dollars per ton, showing a total value of the yearly crop of cotton-seed of over $44,000,000.

Professor James A. Whitney.—We estimate the value of food according to its proportions of nitrogenous or albuminous substances of oily or fatty material, and its starch or sugar. The first supplies the red flesh, the second the greater part of the fat, and the third a portion of the fat and sustains the process of respiration. Sugar, starch or oil, one or all of them, are common in most kind of cattle feed, and either will supply the place of the other. The practical value of the feed may, therefore, be estimated from the quantity of albuminous material in it, and the per centage of either or all of the others. Taking the statements of chemists who have carefully investigated the subject, we find that, disregarding minute fractions, linseed cake contains twenty-seven and three-fourths per cent of albuminous matter, and twelve and three-fourths per cent of oil; whereas turnips have but one and one-fourth per cent of the former, and one-fifth of one per cent of the latter; so that four pounds and a half of oil cake contains as much or a little more nutriment than a hundred weight of turnips. Cotton-seed cake has a trifle upward of twenty-five per cent of albuminous substances, and nine per cent of oil, and is, therefore, worth nearly but not quite as much as common oil cake. Field beans have twenty-seven per cent of albumen and one and one-half per cent of oil, but this deficiency of oil is made up by a large quantity of starch. Sunflower seed has nearly thirteen per cent of albumen and thirty per cent of oil. The per centage of oil is too great for profitable feeding providing it could be extracted and used in the arts. Sunflower seed cake should be a very valuable article of cattle feed. Turning to the cereals, oats have a little more and buckwheat a little less than ten per cent of albuminous matter, the former having nearly twice as much oil as the latter. Wheat has nine per cent of albumen and about two per cent of oil. Of fodder or forage new hay contains about six per cent of albumen, and is consequently worth much more than old hay, which commonly has but four per cent, the rest being dissipated by the slow progress of decay which always first attacks the highly organized nitrogenized bodies.

Bean straw has five and three-fourths per cent, and is consequently well worth saving. Red clover has two and six-tenths per cent, and white wheat straw not more than one and one-third per cent. From these figures we may readily estimate the relative commercial value of the different kinds of feed. Practically, however, there are other elements to be considered in setting forth the real worth of any kind of feed, chief among which is the presence of phosphates required in building up the bony system of the animal. This is computed from analyses of the ashes. For example, the ash of wheat kernels contains forty-six one-hundredths of one per cent of phosphoric acid, while the ash of the straw has but two and three-fourths per cent, and that of the chaff four and one-third per cent. The ash of oats gives fifty and one-half per cent of phosphoric acid, its straw five per cent, and its chaff only one per cent. The ash of Indian corn, which grain, by the way, has also much oil, albumen and starch, shows a still larger proportion of phosphoric acid, has nearly fifty-four per cent, while that of its stalks and leaves (both of these containing sugar and starch) has eight per cent. Rice has more phosphoric acid in it than any other grain, its ash yielding eighty-two per cent and upward. This, with the large quantity of starch in it, makes rice one of the best articles of human food when used with any suitable albuminous substance. Carrots contain more phosphoric acid than any other common root crop, the ash possessing twelve and one-third per cent. As has been frequently observed in the Club by Dr. J. V. C. Smith, a certain degree of bulk is necessary to insure most efficient digestion of the food. By carefully mixing the more concentrated with the less nutritious an average may be obtained that will give the best results. The proportions required between the albuminous food and the sugar, starch and oil have never, I think, been definitely settled, and indeed will vary very much according to circumstances; the colder the stable and more neglected the cattle the greater the quantity of elements for fat-forming and respiration that will be needed. It must also be remembered that the quality of the manure is directly dependent upon the nature of the feed. Some English farmers have held that with cattle fed on oil cake the increased value of the manure is from one-third to one-half the original cost of the cake.

Mr. John Crane.—I have fed rape seed cake, as the English call it, or oil meal, and also this cotton-seed meal, and I like the cotton-seed best, or at least my cows do; and as to nutritive power, I never could observe any difference between them.

KEEPING WINTER SQUASHES.

Mr. Chas. Thorne, Sandy Lake, N. Y.—States that he puts his Hubbards in the cellar, and that they are soon marred by decay's effacing fingers. Is there not a better way?

Mr. W. S. Carpenter.—There is. The cellar is the worst place. They should be placed in a dry room where the temperature stays at about fifty degrees.

The Chairman.—I have kept squashes till April in the lower hall of my house; I have one there now which weighs 115 pounds. There is no trouble and little chances of decay in an atmosphere not too cold and free from dampness.

RUSSIAN TURNIPS RECOMMENDED.

The same correspondent wishing to give as well as to take, added the information that during the past season he raised Russian turnips at the rate of 600 bushels to the acre. Sow in ridges three feet apart and thin out to ten or twelve inches. I find them excellent winter feeding for milch cows and sheep; they sell here at fifty cents per bushel for table use. If they can be raised on unwasted soil, the labor of keeping them clear of weeds would be much less; on highly-manured old ground weeding is a job.

THE SOILING SYSTEM.

Mr. H. A. Chamberlain, Macedonia, Ohio, wrote, to say that he has Quincey's work on soiling cattle, and shall try that system next season with fifty or more cows, unless he learns more against it. He would like the sentiment of the Club.

Mr. F. D. Curtis.—There is no doubt about the practicability of the soiling system. I know of cows kept up continually. They stand on a floor covered with two or three inches of dry sand. A man who adopts the plan must take thought not only for the morrow but for a year ahead. He will need a field of rye for early use; then clover and oats, or clover and lucerne; then finish up the season with corn, planting in drills. This provision of a succession of green crops is easy enough if one thinks beforehand.

Mr. J. A. Wagoner.—My cow feed is cut and mixed with wheat bran. If I have hay, well; if straw, it answers. Cows want plenty of water, and I pour it upon the feed. It has been my experience that with this treatment cows do about as well in winter as in summer. Sugar beets should be given once a day all through the cold weather.

Mr. J. B. Lyman.—Every farmer that gets into the soiling system at all, goes deeper and likes it better. It gives as much milk, far more manure, can be conducted on a smaller area, abolishes many inside fences, and permits clean culture and the extinction of weeds. Rye, clover, sowed corn, sugar beets, will give, if wisely managed, a succession of green or of juicy foods that will keep a stable of cows at about one figure the year round. If they give 360 quarts in June they will give 300 in February. Of course half of the calves must come in the fall.

How to Plow in a Prairie.

Mr. William B. Barnes, Davenport, Iowa.—I present you the result of an experiment this year in double plowing in raw prairie, in this county, by Richard W. Roberts: On May 4th, he commenced plowing with ten teams on eighty acres, and finished all up on the 4th of June. He used a fourteen-inch breaking plow, followed by a common stirring plow, each plow turning up four inches, making a depth of eight inches, on an average. He harrowed the grain with a double lap the way it was plowed, and cross-harrowed it; then planted with a horse-planter in drills. He began to plant on May 17th, and finished on the 23d, making fifty-five to sixty acres double plowed, and twelve acres single plowed, done by the same teams and plows that were used in the double plowing; the corn on single plowing was put in in the usual way by spade and ax, and part of it was in before that on the double, and all finished by June 3d. Now for the result: That on the single plowing, called sod corn, produced eight bushels to the acre of soft nubbins, not fit for market, that would not weigh sixty pounds to the bushel, and was measured in a half-bushel, three half bushels to the bushel. That on the double plowing produced, by weight, forty bushels per acre of good sound merchantable corn. Neither of the pieces were touched after they were planted until they were harvested. The season was unfavorable, for the ground was not wet four inches deep by rains from the 4th day of April until the 5th day of August, and there were no dews to nourish the blades. The cost of the extra plowing was three dollars per acre, and the ground is in order for any crop the coming year without any further plowing. The land was high, rolling prairie, sloping to every point of the compass. The best corn was on the slopes, and that sloping south was equal to the best. This experiment was made by one who is not a practical farmer, and done for his own gratification, as he is an advocate of deep plowing. He gives it to you for the instruction of those who intend opening a farm in the raw prairies.

THE COST OF CLEARING LAND.

Dr. E. F. Peck, Brooklyn, L. I., desired further information as to how it is possible to clear forest land for twenty dollars per acre, which Mr. Lyman estimated as the cost in the mountain regions of the Alleghany and the Blue Ridge.

Mr. J. B. Lyman.—The expression "clearing land" conveys a different idea in different parts of the country. Where it means cutting off and removing all the wood, grubbing out the roots, and drawing the stumps, as is understood on Long Island and in New Jersey, it cannot be done for twenty dollars an acre; not for three times twenty. In the mountains of North Carolina, of which I spoke, the trees are not felled, but girdled. There is not a heavy growth of brush; what there is can be cut, piled and burnt at moderate expense. Two crops of corn are taken from the surface, and then grass seed is sown with oats. The freedmen will take the job of fencing and clearing for three crops of corn. The growth is large, sixty to seventy cords to the acre, chestnut, oak, poplar, ash, hickory, gum and beach, now and then a black walnut, and in places a good deal of sugar-maple. Girdled trees decay faster than stumps; but it is a slovenly and wasteful practice to make no use whatever of such timber. It ought to be burned, and the ashes leached for potash.

PRUNING GRAPE VINES.

Mr. P. T. Quinn.—There are about as many different methods of training grape vines as there are varieties under cultivation. This is not strange from the fact that the same method of training practiced on the same vines does not always give the same results. Intelligent growers are compelled to vary the summer as well as the winter treatment of their vines in accordance with surrounding conditions, which include location, soil and atmosphere. The bearing grape vine is subject to atmospheric changes, and some of these are so common in the experience of growers that in successful culture no set of rules can at all times be strictly carried out in the management of the vineyard, or even in garden culture, so that any method of pruning or training, when intelligence directs the labor, is at all times subject to be varied to meet the contingencies that arise during the growing season. With a wet and warm summer the fruit will do better, ripening more uniformly, with close summer pruning; while on the other hand, when the months of July, August and September are dry, with a parching atmosphere, more foliage is needed to bring the crop to maturity. During the past season my attention was called to a number of such instances, where the grapes were seriously injured, a great deal of the fruit not ripening on account, as far as I could judge, of the effects of too close summer pruning. In the extensive vineyards of California no system of summer pruning is practiced. When the vines start to grow in the spring, at the close of the rainy season the superfluous shoots are removed, when they are only a few inches long. No rain falls from the time the fruit is set until it is gathered, and all the shoots are left on to grow as long as they will, in order to give enough of foliage to ripen the crop.

But no matter what distance apart vines are planted, nor in what location they are growing, whether in vineyard or the garden, all intelligent growers who are conversant with the character and habits of the vine agree upon one point, that is, on the necessity of winter pruning. This annual cutting back of the last season's growth should be done some time between the 1st of December and 15th of February in the northern and middle States, and of course earlier further south. To give explicit directions for vines that have been neglected for a number of years is no easy matter without beginning at the start, and following some general plan from the first.

If those who plant vines would decide upon some system of training, and follow this from year to year, adopting such changes as experience would dictate, it would then be comparatively an easy matter to offer some suggestions that would be of value. One man writes that he planted a dozen of vines six years ago; that they have grown well, covering the top of an arbor. These vines have never been pruned, and the last two years the fruit does not ripen and drops off badly. This correspondent wants to know how to treat these vines so that they will ripen their fruit. In this particular instance it is easy to see where the trouble lies, too much fruit and wood are left on for the strength of the vines. The best treatment for such vines would be to cut them back, making a fresh start, and train as if they were only one year old. The next best is to cut back this winter all the young wood, leaving only two well developed eyes on each shoot. In the spring, when these shoots are about two inches long, rub off the weaker one of the two. By following this method the number of bunches will be lessened, but what are left on are likely to grow to full size and ripen uniformly. Too close pruning at first on a neglected vine often injures it for a number of years, so that in treating old vines of this kind care must be taken not to do too much the first or second year.

On young vines planted only a year or two, the trouble comes generally from leaving too much new wood before the roots are well established. At the time of planting a young vine the shoot should be cut back, leaving only three eyes. The first year one shoot, and no more, should be permitted to grow. During the fall or early winter of the first year this single shoot should again be cut back to four or five eyes. In case the first year's growth was strong, then two shoots may be allowed to grow the second year. But if not, it is better to train only one, so as to have a strong vine before any fruit is produced.

At the annual pruning of the second year the two shoots may be left each two to two and a half feet of wood. On good soil and strong young vines to begin with, the third year these vines should produce from five to eight pounds of grapes to the vine of Hartford, Prolific, Concord or Eumelan. With the Iona or Delaware the product per vine will average less at this age. For garden or field culture the "arm system" of training is growing more popular among those interested in vine culture. These arms, when once started, can be extended any length from year to year, and fill up any space allotted. When the vines are two years planted then a structure for their support should be put up.

The wire trellis now in such general use by grape growers is easily made, not expensive, and answers the purpose better than any other kind of structure that we have seen. The posts, which should be eight and a half feet long, are set in the line of grape rows every sixteen feet, and about two and a half feet deep. These wires are then stretched along these posts. The first wire should be about eighteen inches above the surface, and the second and third the same distances from each other. The wire is wound around the end posts once or twice, and then drawn very taut and fastened to each post by a wire staple driven firmly into the post over the wire. Unless the wires are well stretched when putting them in place, the weight of the vines will cause them to sag in the summer.

In fastening the two arms of the young vine to the lower wire on the trellis, it will be found better to cross them, running the right arm toward the left and left toward the right. For tying the arms tarred twine will answer the purpose very well. Each year these arms can be extended until they meet those of the next vines in the same row. Where wire is used instead of wooden slats, the air circulates more freely around the vines; besides, it will be a less expensive structure at the end of eight or ten years. Narrow strips of wood will rot, and must be replaced every four or five years at least.

The posts for grape trellis should be carefully set in the ground, and the earth packed well around at the time of putting them in. There is always a heavy strain on the posts at each end of the row, and to guard against sagging there should be another post set on the inside, and the top of it nailed to the outer post as a brace, to keep it in position.

From each eye on the arms a single shoot should be permitted to grow, and each one of these shoots will produce two or three bunches of fruit. At the proper time for winter pruning each year these shoots are cut back, leaving one or two eyes, from which the strongest shoot is again selected for a fruit-bearing cane.

On old vines running over arbors a large share of the last season's growth should be cut off before the sap begins to flow freely in the spring. If left until March or April the vines lose strength by what gardeners call "bleeding" during the summer.

Adjourned.

December 20, 1870.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Cruelty to Animals.

Mr. Henry Bergh, by invitation of the Chair, came before the Club, and gave a most interesting statement of the steps his society has taken for the prevention of cruelty to animals. Mr. Bergh is a gentleman of culture and fortune, who spent many years abroad, mostly in St. Petersburg. Upon his return to his native city he was struck with the cruel and brutal way in which many classes of animals are abused by the most vigorous and progressive civilization he had ever seen. His spirit was stirred within him, and he has devoted his time, his zeal, his personal culture, and his fortune, to the work of protecting the dumb, devoted servitors and companions of man from the savage passions and torpid indifference of unchristian hearts.

He said the transportation of cattle had occupied much of the attention of the society, that the mal-treatment to which they are subjected is uncivilized, inhuman and horrible. Sometimes, in fact not unfrequently, they go without food or water for six consecutive days; that when they reach their destination they are hurried to the slaughter-house, and thence their feverish and unhealthy flesh finds its way to our tables. Meanwhile, the presidents of the roads drink their champagne and smoke their cigars, and the cries of the suffering creatures go up to heaven unheeded. This ought to be reformed altogether. Street cars are a very great improvement, and ought to be generally adopted. The check-rein is an abomination, and the horses which draw the most fashionable equipages are frequently the most tortured by inhuman contrivances calculated to induce a proud carriage of the head. Again they are clipped, and this too in the winter season, when they need their covering most. Some, too, are singed with hot irons. Cutting off their tails was for a awhile unfashionable, but "some persons in Twenty-fourth street are at it again. I shall watch them, and catch them I doubt not." The feed of horses is much adulterated with plaster of paris and marble dust. Trucks eighteen feet long are used, and a single pair of horses are compelled to draw 9,000 pounds. The street cars are overloaded. Often 100 persons are packed into a car capable of seating but twenty, and two horses pull them. Mr. Bergh then spoke of the practice of bleeding calves to make their flesh white, and of the cows kept by Brooklyn dealers in swill milk. Among the good results of the society's efforts during the past year is the establishing of drinking fountains throughout the city, in which poor, tired horses can plunge their noses. Another evidence of its influence is the fact that no less than sixteen States have started similar organizations. Even Canada has fallen into line, and is moving forward in the good work. A lamentable fact is that, though the society receives no State aid, the Legislature is doing its best to break it up. Last winter there was only a majority of two votes in opposition to this movement. But the effort will be renewed. There are enough who would like to see a restoration of the old practices, calves' heads being ground upon wheels of overloaded vehicles, horses being beaten with clubs, and the like. A singular thing is that the society received no aid from the clergy, notwithstanding the fact, acknowledged by all good men, that it is a Christian duty to ameliorate the condition of our dumb friends everywhere. No man, concluded the speaker, can be kind to his wife and children who is unmerciful to his beast.

The Chairman.—The mission of Mr. Bergh and the moving way in which he has presented it need no eulogy from this Club. As a humane and admirable man, as a missionary penetrated with the spirit of the New Testament, and urged by the rarest and most elevated charity, he has for his sustaining power the same high consciousness that braced the spirit of John Howard, and has written his name in volumes more precious than any scroll of earthly fame. More than once have I seen Mr. Bergh standing in a pelting storm at street corners, and watching for those cruel scenes which were often so revolting whenever our streets became blocked with heavy snow storms. A thousand times has he stepped in to check the brutal wrath of a rough driver, rising before him like an accusing angel, and armed with the legal right to protect the mute and tortured beast.

If I did not misunderstand Mr. Bergh he informs us that active efforts will be made this session, as they were last session, to destroy the authority that has hitherto given him so much ability to enforce humanity upon inhuman men. It would be a long stride toward barbarism to abolish that law, and I hope at our next session that the protest of this Club will be uttered in words neither hesitating nor feeble against the repeal of the law.

Sheep.

Mr. Jackson Graves, Dryden, N. Y.—Will you please lay before the next meeting of your Club the following subject? In what locality can keeping sheep be made the most profitable when the price of land, climate, and all other things which pertain to the business, are considered? I desire a healthy locality where the climate is not too rigorous. Is any part of Virginia well adapted to it?

Mr. Warren Leland.—The way prices are now a man cannot afford to go into the wool business as a specialty except on remote and cheap lands. Australia alone, where land costs nothing, grows as much wool as we can spin and weave in all our factories. The way to profit on sheep is through good mutton. Let him take say fifty Southdown ewes, and he will get about seventy-five lambs the latter part of February or the first of March. They should be well tended, fattened fast, and sold as early as possible. Well dressed, fat, spring lamb commands a fancy price in New York. If he makes choice mutton the chief thing, and lets the wool come in as a side matter, he will get on in the sheep business. If wool only is his ambition, I recommend the frontier counties of Texas, where grass land is one dollar an acre.

Mr. F. D. Curtis.—Our worthy host of the Metropolitan is sound on the sheep question. England finds the sheep business profitable and she goes for mutton mainly, the wool being only an incident. Yet in a small, poor sheep there is little or no profit. Let him go for large, long-wooled breeds, and fatten them as near as he can get to the best market for choice mutton.

FERTILIZER FROM CHARLESTON.

Mr. Charles H. Cohis, Palmetto, S. C.—I wish to say to the farming cummunity through your admirable and widely-read report, that the phosphated beds of this State are the source from which they can obtain a cheap yet valuable manure, especially for grain. Our fossil bones are found in beds of great thickness and extent. It has been supposed that sulphuric acid was required to fit them for use in the field, but fine grinding will answer in room of the acid. The phosphate rock is ground to the fineness of flour, and in that condition it is equally as available as feed for plants, as bone-meal, and is equally soluble by the acids of the earth. It can be at present furnished at much less than one-half the cost of flour of bone.

BUTTER MAKING, IN SUMMER AND WINTER.

Mr. J. P. Corbin, Whitney's Point, N. Y.—One of the members of your Club, in conversation with me at your late exhibition, asked me, as an old butter maker, to write out my ideas in answer to certain questions which he put to me in writing. I send my answers with hesitation, for I can make elegant butter easier than I can write fine English.

1. How deep should milk be set? If in the common eight quart pans, and the milk is to be skimmed, they should not be filled over half full in hot weather, but in cold weather they may be filled as full as convenient to handle. If all the milk is to be churned, then fill them full or use pails. Many of my acquaintances use the large patent pans with good results. The size of the pan is made according to the size of the dairy, requiring only one pan for a milking. They are placed in a vat with an ice-box at one end, and so constructed that water may pass from the ice under and around the pan, and escape at the other end or come back to the same end and dipped on to the ice again. The milk may be brought and kept to the proper temperature in them. Cream will raise in a higher temperature than it will do to churn, but it is advisable to keep it about right for churning, which is fifty-eight to sixty-two. There is a factory system of making butter carried on in some places with very good success. They use pails as coolers, eight inches across and twenty-two inches
They are filled with milk, then set into a pool of cold, circula-
water the depth of the milk, and kept there until ready to be
d.

w long should the milk stand before skimming? From
to forty-eight hours, when it should be sour, and lopper on

the bottom of the vessel. In the factory system they usually take the cream off before the milk sours and make cheese of the milk. They let the cream stand until it sours a little before churning it.

3. How old may cream be to make good butter? It should be churned very soon after it is taken off or is broken up, as sour cream will very soon whey, or rather commence to decompose after being disturbed, especially in hot weather. I think it advantageous to churn all of the milk rather than to skim and churn the cream only, if coolers or the large pans are not used. The butter will be of much better grain, and usually of better flavor, and commands a higher price, besides, there is less waste of cream sticking to so many vessels and utensils, and it also saves skimming and much washing.

What is the best churn? The up-and-down dash churn. There are many hundreds of churns patented, and I have seen a great many, and the results of them. I have visited a great many butter-makers, and many of the most noted ones, with a butter worker, and have seen and worked butter made by many different kinds of churns, and do not hesitate to say that I never found as good butter as that which was produced by the old up-and-down dash churn. The only objection to the dash churn is, it is hard to work, but the gain in quality of butter more than pays the difference of labor.

5. Why is some butter so slow to come? There are many reasons for this. The cows may not get proper food or water, or sufficient salt. Perhaps the milk or cream is not properly cared for, or it may not be of proper temperature, which is of the utmost importance both for the production of good butter and the time required to bring it. If below fifty-eight degrees, the buttery particles do not readily separate, and if above sixty-two degrees, the grain, color, and flavor of the butter are all materially injured, besides it will not come as readily. The shape and construction of the churn, also the way it is operated, will make quite a difference in bringing the butter; also, in the quality of it. The churn should be made with a bulge about one-third from the bottom. The dash should be two pieces, three to four inches wide, halved together, and as large as will go on the bottom of the churn. There should not be any notches or holes through it, but the under side should be cupped out, and very fine holes, not larger than a knitting-needle, through from the cups. In operating, the dash should always be brought out of the cream and to the bottom of the churn. The cups will carry air down to the bottom of the churn, and the pressure will force it through the fine holes into the cream, which will help to change it and give color to the butter. There should be

a tube about three inches long through the lid, with a half or three-fourth inch hole through it so the air may pass through it freely. The dash should not be operated fast, causing too much agitation, which will make the butter come pasty white. When everything is all right, it will not require at any time over thirty or forty minutes to bring the butter, and it should not be done in less than about twenty.

6. How should the buttermilk be got out? Should the butter be washed? This is a question that has been discussed, perhaps, more than any other connected with butter-making, and is not settled with small or family butter-makers; but, in the best butter-making districts, butter is washed, and dairymen in general wash it. My way of removing the buttermilk from the butter is to put the butter from the churn into water enough to cover it, or more, and work it but very little, only open it so the water will come in contact with the milk; then pour off this milky water and put more on, and handle as before. Twice rinsing will generally cleanse any butter of all its milk, if properly handled. It is an advantage to put a little salt into the second water; it will help to extract the milk, also toughen the the grain of the butter. Butter is not near as liable to get injured by washing the milk out as it is when the milk is worked out; besides, the sourness will all rinse out, which is almost impossible to be got out by working, without injuring the grain.

7. How much salt to the pound? If for use, suit the taste, or the market it is designed for, but if for long keeping there should be grains of salt in it after it has dissolved all that it will at present. About an ounce of pure fine salt to a pound of butter is about right for keeping or for the general market.

8. How should butter be put down? Sprinkle the package with salt and then press the butter firmly, but not pound it, as that will break the grain. When the package is full, spread a cloth wet in brine over it, and put about an inch of salt on it, and cover with brine, and see that it is kept covered. Butter that is properly manufactured and put down may be kept perfectly sweet for years. The package should be such as the butter will sell best in, but for keeping, white oak firkins are best.

9. *Butter in July.*—In very hot weather the cows should be kept as quiet as possible, with plenty of feed and water. The milk should be cooled to the proper temperature, and kept so, and watched closely, and, as soon as sour, churn the cream, and, as soon as the butter comes, wash it in cold water, but put no ice on the butter, as it will

chill and whiten it. Salt it pretty strong, and keep it in as cool a place as possible, and work it when it is soft.

10. *Butter in January.*—In cold weather heat the milk by setting it over hot water until a skin forms on the top, and wrinkles up, then set it where the temperature is about sixty-two degrees. If the cream does not raise readily, warm the milk again. If the cows have sweet food, even if nothing but sweet hay, you will have no difficulty in making butter in freezing weather. But it will not do to keep cream till it has a butterish taste, for you can never get that taste out of the butter, nor to let the butter get so cold that you must warm it in order to work it over.

CHEAP AND ABUNDANT RAISINS.

Mr. Benjamin Ellershaw, Milwaukee, Wis.—California is the best grape country in the world. It ought to supply the whole United States with raisins, to be retailed at ten cents a pound. To go into the manufacture of wine requires large capital and great skill. But the small farmer, with nothing more than ordinary farm-working capital, could raise, dry, and pack up five to twenty tons of raisins, in ten and twenty pound boxes; and, themselves, make the boxes in the slack season. The market for fruit, grapes, is necessarily very limited. To supply the United States with raisins would profitably employ the vast quantity of unskilled labor. The true raisin grapes will, of course, have to be introduced and grown; that can be done very readily. The raisin grape is a meaty, fleshy grape. By the time that three Pacific railroads are made, the Californians may, if they please, be ready with their raisins; and then, ho! for cheap raisins. In some parts of Minnesota, Iowa, and Wisconsin, it is difficult to grow anything but Siberian crabs; but a pie made of Siberian crabs and raisins is excellent. Three-fourths Siberian crabs and one-fourth raisins make a good pie.

HOME-MADE PHOSPHATES.

Prof. James A. Whitney read the following paper: For home-made phosphates, bones are the only available material; and it is safe to say that on almost every farm enough of these are annually wasted to double the yield of an acre. Some careful computer of statistics has calculated that raw, fresh bones are worth five cents per pound for manure. The estimate seems excessive, but is nearly correct, provided the bones are prepared and mingled with the soil, so their valuable constituents may be readily taken up by the roots of vegetation. The valuable portions referred to are the organic matter, which yields ammonia by decomposition, and phosphate of lime, which is the source of phosphoric acid to the plant. In order to secure the best results from the bones used as manure, we must reduce the phosphate to a condition so fine that it will be readily dissolved when placed in the soil; and we must also insure the decay or decomposition of the organic matter without losing the ammonia produced. The first step in this process of preparation is to break up the bones to small fragments by mechanical means, and then to place them where the chemical action of the decaying organic substance of the bone will insure the disintegration of the phosphatic parts to a porous and pulverized state. Some material must be used to retain the ammonia, either by absorbing it, as muck and dry earth does, or by combining with it in some chemical way, as is the case when ground plaster or gypsum is used.

The Breaking-up of the Bones.—They should be reduced to fragments of two or three inches in length, and not more than one-fourth or one-half an inch in thickness. This is a matter of no little difficulty, and many inquiries have been received as to the best means of doing it. Manufacturers of bonedust and bone-meal use mills weighing many hundred weight, and composed of three pairs of ribbed cast-iron rollers, the pairs being arranged one over another, and geared to move simultaneously, so that the bones, passing between the upper rollers, are broken into large fragments, and then, going in succession between the others, come out from the lower ones broken fine. These rollers are commonly about three feet in length in the bone mills, in order to permit a number of bones to be ground at once; but there is no reason why a mill, made on the same principle, with narrow rollers, and calculated to grind one bone at a time, should not be cheaply put in the market by manufacturers of farm machinery. Such a machine could be run by an ordinary horse-power, and one in a neighborhood would grind the waste bones on a score of farms. Until such an apparatus is available, however, the farmer will have to rely on hard pounding by hand to bring the bones into condition for final preparation for manure. It may be here remarked that it is no use to undertake to dissolve the bones whole, either by fermentation, as in the method we propose to first notice, or in the manufacture of bone super-phosphate. Any such attempt will end in vexation, for it is absolutely necessary that a large surface be presented to the dissolving agent, and this can only be insured by considerable comminution of the material.

The bones may be broken up with an old axe, but this is slow, and requires very hard work. Provided the farmer has any considerable quantity of bones to use up in this way, say upward of ten or fifteen bushels per year, it will pay him in the long run to obtain from some foundery a bowl-shaped, cast-iron trough and a heavy pestle. Put the trough, or mortar, if you please to call it so, upon a solid stone for a foundation, and suspend the pestle over it upon the end of a spring-pole. This apparatus will last for twenty years, can be operated with as little waste of muscular effort as any hand power machine for the purpose, and costs much less than any grinding-mill can be made or sold for.

The bones, having been broken fine, should be packed snugly in a cask or tight box, with some absorbent material like muck, fermenting horse manure, or even dry earth. The absorbent material should be sufficient in quantity to fill up all the interstices between the fragments of bone. It is best to fill the cask or other receptacle gradually, by putting in successive layers of bones, filling the crevices with the absorbent, and then saturating the whole with liquid manure or drainings from the dung-heap. In warm weather this will ferment very rapidly, the process being commonly completed in from two to ten weeks. The organic matter which permeates every pore of the bones, and forms about four-tenths of their weight, decays, and this decay corrodes the phosphate or mineral portion, so that it disintegrates to the required fineness. Meanwhile the ammonia given out will be retained in a great measure by the absorbent, but some will be likely to escape, especially if horse manure, in place of muck or loam, is used. To prevent this, therefore, four or five inches of dry, fine muck may be placed upon the top of the mass when the cask is filled, or, in lieu of this, a layer an inch thick of ground plaster may be used. When the mass, after thorough fermentation, has become cold, which may be ascertained by thrusting a rake-handle down into it, it may be turned out and shoveled over, to make the whole of uniform consistency and richness, after which it is ready for use. Beside being pulverized or being made finer by the method just explained, there is good reason to suppose that a portion of the phosphate—tri-calcic or insoluble phosphate, commonly so called—of the bones, is really dissolved, and exists in solution in the mingled particles of fine bone mineral and ammonia rendered absorbent. We know that carbonic acid water and ammonia in solution both hasten the dissolving of mineral phosphates in the soil, and there seems no good cause to doubt that the same thing occurs with more intensity in the decomposition of the organic matter of the bone which yields ammonia, and of the absorbent which evolves carbonic acid, in the composting process we have just described.

This method of utilizing bones has been first mentioned, because, for a given weight of raw bones it will give a greater quantity of fertilizing material than any other known process. The production of super-phosphate, however, will involve much less delay, much less evolution of bad odors, and, if properly managed, less of disagreeable and dirty work; but is so often mismanaged that farmers are frequently led to believe that it costs more than the value of the product as a fertilizer. After having broken or pulverized the bones, as previously explained, the first step in converting them into super-phosphate is to provide a suitable receptacle in which to carry on the operation. Some have recommended the half of a barrel; but when we remember that oil of vitriol will char wood like fire, the objection to this is apparent. Probably the best receptacle would be a large vessel, holding from thirty to sixty gallons, and lined with lead, upon which the vitriol has comparatively little action; but this would be too costly for most farmers. In practice, the best, all things considered, will be obtained by digging a hole in the ground, lining it with stone or brick, firmly bedded in the earth, and closely filling the joints with clay, or, instead of this the lining may be made wholly of clay rammed hard. The broken bones placed in the receptacle, which we will suppose of basin form, should have scarcely water enough poured upon them to fill the spaces between the fragments and wet the whole. The sulphuric acid or oil of vitriol, which should be bought by the carboy for about two and one-half to three and one-half cents per pound, should be added in the proportion of about one pound of acid to three of bones. The water should always be poured in first, as above mentioned; as by this means the distribution of the acid will be rendered more uniform, and the heat evolved by the combination of the water and acid will permeate the mass more readily, and aid the conversion to super-phosphate in proportion. The quality of the super-phosphate depends very much upon the fineness of the bones, and the proportion of the sulphuric acid used. If there are large fragments of bone, their inner proportions will be likely to be very little affected, and they will retain much of their former comparatively insoluble character. If an insufficient quantity of acid is used, the conversion of the phosphate into super-phosphate and sulphate will be partial, and the product, although not so rapid in its fertilizing action, will show its effect for a greater length of time; and this is sometimes sought by purposely limiting the per centage of acid to secure the result just hinted at. On the other hand, if the acid solution is in excess, and especially if the bones be very finely comminuted beforehand, the phosphoric acid, or much of it, may be wholly separated from the lime and exist uncombined in the acid. This is somewhat at variance with the commonly-received opinion, but Berzelius is authority for the statement. This free acid in the solution would in a great measure be lost when the fertilizer was mingled with the soil, as it would frequently be washed out by rains before it could combine with lime in the soil to slowly dissolving tricalcic form in which phosphoric acid is held disseminated in the ground. It should be noted in this connection, that, although theoretically the nitrogen of the bones, when the same are made into super-phosphate, may be more or less retained in the form of ammonia, there is very little reason to suppose that this amounts to much in practice. The loss of organic matter, some forty per cent of the weight of the bones, amounts pecuniarily, it is roughly estimated, to about one-half a cent per pound of bones. The same ratio holds good to another, but less common mode of reducing bones, viz., digesting them in wet ashes, which, although claimed to produce excellent results, is of less utility than either of those previously explained.

Adjourned.

December 27, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

THE ADVANTAGES OF QUIET FOR STALL-FEEDERS.

It arose from a letter sent by Gibson Binns of Red Stone, Pa., asking instruction "concerning the treatment fattening sheep should have during the winter months." Is it better to confine them to yards and shelter, or give them a field in connection with the shelter, and allow them to graze at large? He has practiced the latter method for some ten years, always endeavoring to have a good coat of grass on the field, and he thinks he thus saves largely in rough feed, yet the increase is small during the cold weather. "The past fall," he continued, "I had concluded to pen my flocks to feed for April market, when I saw that Warren Leland didn't pen his geese, then why should I pen my wethers? and Mr. Leland is held good authority. But what I wish to know is whether any of your correspondents have tried the two methods, and are able to give definite results. John Johnson gives the yarding process, but does not say that he ever tried the other. The meat question is a very important one, and all the light that can be thrown on it will be gladly received."

Mr. H. L. Reade.—It is a theory long since established that all physical action involves loss in food that is taken into the stomach. It must, therefore, be settled that the less exercise animals have while they are fattening, which is not incompatible with good health, the better. Sheep should, therefore, be kept in dry stables, having ready access to pure water, and, if fed with abundant and proper food, they will do best. If they are allowed to ramble they will get but little food from the sere earth, and that little will in no sense compensate for the loss which the travel for it involves.

Mr. F. D. Curtis.—I agree with Mr. Reade most emphatically. One of the best sheep-feeders in the country, Jurian Winne, found by experiment that the portion of his flock kept on the second floor of a shed fattened fastest, for the reason that they didn't waste carbon in exercise, or in keeping the cold away. Mr. W. keeps his sheep just as quiet and just as comfortable as possible. They are fed by one man, no dog or stranger ever comes near them. They have their hay, meal, and roots regularly, and as much as they can eat. Plenty of clean rye straw is given them for bedding. He says he loves to see a sheep lying on a clean, warm bed, for then he knows they are turning meal into mutton.

A BETTER METHOD OF OBSERVATION FOR AGRICULTURE.

This was the subject of an able paper prepared by Prof. Andre Poey, late director of the observatory at Havana, Cuba, and still more recently connected with the Smithsonian Institute, at Washington, D. C., and the author of the exhaustive and interesting report on meteorology published recently in the report of the department of agriculture.

Mr. J. B. Lyman.—I see, Mr. Chairman, that Prof. Poey's ideas are important and valuable. He says, for instance, that the growth and maturity of plants can be materially affected by glass of various tints, and that results quite significant can be obtained by experiments nicely regulating the temperature of the root and of the stem, keeping one cool and the other warm. Probably we have not had before us a subject more progressive in agriculture, and I move that the memoir be referred to a committee with instructions to digest Prof. Poey's plan, and condense his views in a form suitable to reach the popular mind.

Mr. F. D. Curtis.—I wish to reduce the ideas in the paper of Prof. Poey to my own practical notion of things. I have a field sloping to the north, which a few years ago, I observed, was covered with moss growing underneath the clover. Older farmers than I said this unusual circumstance was caused by the dampness underneath the clover; others gave it as their opinion that the land was sour. None of them were right. I have reseeded the lot with timothy and orchard grass, which does away with the clover theory. A hundred dollars' worth of fresh lime has been spread over the surface of the field to warm and sweeten the soil, and last summer was an exceedingly dry one, but the moss still exists; therefore, it must be the result of climatic or atmospheric laws, which no farmer understands, and they would like to have some one somewhere to study out these mysteries, and teach them the laws of their growth and prevention.

Mr. N. C. Ely.—I will name Messrs. Lyman, Whitney, Bragdon, Curtis and Reade, as persons well fitted for the work suggested.

Society for the Prevention of Cruelty to Animals.

The following preamble and resolutions were offered by Mr. J. B. Lyman, sustained in remarks by Drs. Smith and Trimble, and passed without a dissenting voice:

Whereas, Mr. Henry Bergh, president of the Society for the Prevention of Cruelty to Animals, at our last session recited with admirable manner and praiseworthy spirit the efforts of that association to prevent the torture and abuse of the dumb brutes, and to suppress cruel and dangerous modes of transporting live stock, and alluded to a nearly successful effort at Albany to procure the repeal of the law which sustains Mr. Bergh and his associates in their humane and Christian activities; therefore

Resolved, That the Farmers' Club of the American Institute have learned with surprise and astonishment of a concerted action on the part of nearly one-half of the Assemblymen of this State for procuring the repeal of the law which created the Society for the Prevention of Cruelty to Animals.

Resolved, That the efforts and acts of this society have been useful, humane, wise, and beneficent only; that in this city alone it has prevented a sum of needless suffering which no man can estimate; it has arrested a thousand brutal whippings; it has required loads to be proportioned to the strength of the animal that draws it; it has protected suffering creatures from exposures to icy storms; it has stripped the harness from draft animals that were beaten because they were lame, and pounded because their flesh was raw from the galling of the collars; it has stopped the clubbing of horses; it has interposed between the greed of unfeeling men and the sufferings of calves, and lambs, and poultry, on their way to slaughter-houses; it has done much and proposes to do more in abatement of that great nuisance and dishonor to our civilization, the systematic and wholesale torture of cattle by bruising, tramping, and goring, by thirst and fever, and hunger and cold while in transit from western prairies to eastern cities; it has caused the arrest and urged the trial and punishment of knaves who would, for greed of foul profits, poison our population with milk of cows fed on swill; milk drawn from animals burning with slow fever and tottering with gangrene; it has caused the arrest of cock-fighters and dog-baiters; it has urged the disuse of severe bits and cruel goads; it has penetrated to the recesses of slaughter-pens, and insisted, if animals must die for man, that the stroke be made quick and dexterous, so as to prevent torture and death by inches.

Resolved, That the repeal of a law by which so much good has been accomplished would in no respect promote the general weal, is not required by the liberty of any right-minded citizen, is not called for by the community; such repeal would be a blot on our statute book and a libel on the refinement and Christianity of this generation.

MANAGEMENT OF MARSH MEADOW.

A communication from Mr. James J. Phillips, Chuckatuck, Va., informed the Club that he has about fifty acres of salt marsh which has been diked for about two years. The salt grass has given place to every variety of weed found in the fields thereabout. What shall he do with it?

Dr. Isaac P. Trimble.—I have seen in Salem county, N. J., many fine crops of corn growing on land over which once rolled the sea. But the enterprising owners ditched and diked and put in sluice gates. The last is especially important, and success will be just in proportion as these gates are kept in order. The day is not distant when the broad and useless marshes between Newark and this city will be reclaimed in the same way; in fact, the good work is already begun.

Mr. H. L. Reade.—A gentleman in Connecticut who has had successful experience in this matter, found that plowing is the only remedy for weeds. My advice to the questioner is that he treat his reclaimed marsh as follows: Get the water out of it, plow and plant corn, cultivate often enough to keep the weeds all down, and plow after the corn comes off. After two crops of corn he can seed down with timothy and herd grass. In the wet places the herd will take best, on mellow and dry parts the timothy.

A FIELD OF STRAWBERRIES.

George Gibb, Holden, Mo.—I am farming on 100 acres of black rich prairie land; have had some experience with the culture of strawberries on a small scale with good success. I wish to plant one acre if the spring proves favorable. I want a few hints on the field culture of strawberries.

Dr. F. M. Hexamer.—Rows three feet apart, plants two feet apart in the row. Fertilize if you want big berries, and by all means mulch. Why does he plant so much as an acre? Is not half an acre ample? Where does he propose to find market for so many, and can he get the labor just when he wants it for picking? He should consider these points before he acts. Of sorts, begin on Wilson, and on that soil Jucunda and Triomph should prosper.

Observations on Orchards.

Mr. E. S. Hulin, Longmire, Tenn.—I have bought a farm here, on which is a large orchard that has not been pruned or tended since the beginning of the war. Many of the trees seem to be dying from neglect; blackberry briars cover the face of the ground. I want to know what fertilizers to use, and how to use them, to restore the trees to their former thrifty and bearing condition.

Dr. Isaac P. Trimble.—I know a section of country where the farmers have found what they suppose more profitable employment, by carting ore from iron mines, and have so neglected their farms, and especially their orchards, that they have become almost worthless. The chief crop of the apple trees are dead branches, suckers and moss. I would certainly take off the dead wood and suckers; but no more. Trimming alone will not restore such an orchard. I would plow and fertilize, and if lime had been found useful it should be used freely. In the neighborhood alluded to, one farmer had applied lime years ago; that was a start; grass grew. It is now the pasture ground of horses, cows and *hogs*. It is more valuable than a dozen orchards of the same size in that part of the country. Let him plow, sow lime, then ashes, and make a compost heap of turf, leaves and muck, and mulch with straw.

Eggs in Winter.

Mr. E. Wilcox, Trempealeau, Wis., asked information concerning various points in the winter management of his brood of hens.

Mr. J. B. Lyman.—We have had frequent talk about the summer care of poultry; but I don't remember that anything has been said on the subject of the attention they ought to have during the cold season. It is an important matter; enough so, it seems to me, to warrant the appointment of a committee whose duty it shall be to gain definite information, and I move that such committee be directed to visit a number of poultry yards and report on the best they find, and how hens are persuaded to lay while the boys are skating and the girls are out sleigh riding.

Dr. Isaac P. Trimble.—It is an important matter. I don't know as I have the best system; but desire to know if there is a better one. Therefore I second the motion.

The Chairman.—I will name Messrs. Lyman, Hexamer, Smith, Curtis and Trimble.

How to Grow Chestnuts.

James Butler, South Hill, Penn., would know if chestnuts will grow after having become perfectly dry, and if not, how should they be cared for.

Mr. A. S. Fuller.—They are dead when dry. If kept moist and warm they would mould in a week. Mix them with sand soon after gathering and bury them below the action of the frost, and they will come out good as new in the spring.

Mr. F. M. Hexamer.—It will do to plant them in fall in a light sandy soil.

New York City as a Source of Manures.

Professor H. E. Colton.—For many years farmers living near the city of New York have drawn from its numerous stables and manufactories large quantities of valuable manures. From the stables of New York city and Brooklyn it is roughly estimated that 400,000 loads of manure are annually hauled. This manure is usually paid for at the rate of fifty cents per load, though in winter as much as $1.25 is frequently paid. The refuse bones of New York are also eagerly sought after for conversion into ground bone, superphosphates and other fertilizers. It is estimated that from 100 to 125 tons of bones on an average can be gathered in New York and Brooklyn every day. Among the manures which are neglected are the carcases of animals, horses, dogs, etc., which are gathered from the city streets. Singularly enough, these are dumped into the bay, instead of being used, as they might be, for the production of valuable manures and chemicals.

Sewage of the City.—But the great fund of neglected fertilizing material, of which we wish particularly to speak, is the nitrogenous matter which passes off through the sewers. This now goes off into the North and East rivers, polluting the waters of those streams, and at times sending forth a stench offensive and unhealthy. The extent of district drained by some of these sewers is immense. The great sewer of Brooklyn, which empties into Wallabout bay, just in rear of the marine barracks of the navy yard, drains 1,468 acres of ground. This sewer so pollutes the waters of the bay that the naval officers consider it injurious to vessels anchored near its mouth. At low tide, the immense mass of filth from it is distributed over a surface of low, flat marsh, which often sends forth a powerful stench when exposed to the sun. Dredge-boats must be constantly employed to deepen the channel near its mouth; and the mud gathered by them is used to fill up the adjoining marsh. No farmer, as far as I can find out, has yet tried this muck upon his land, though it must contain large quantities of the sewage wealth, in spite of the presence of some salt.

The Depth of New York Harbor.—This immense amount of sewage, run into the rivers, must eventually have its effect on the depth of the harbor. It is contended by some that the water on the bar off Sandy Hook is not so deep now as in years past; that more water comes in than goes out; that this is the reason why the filth and carrion of the streets is thrown back on the shores of the bay, instead of being taken out to sea. If this be true, the harbor must eventually grow shallower, or have bars formed across it, unless some other method is adopted to carry off the sewage.

How to Utilize the Sewage.—How to do this, is a point which has been much discussed in England. As we do not drink the water of our rivers, it has not heretofore been of so much importance in this country; but now the health and commercial prosperity of our city demand it. Authority has been given and a commission raised by the Legislature for the erection of permanent docks and piers. Our plan for these structures would be to make them of stone, the piers hollow, really a vast stone tub or box, say 100 to 150 yards long and 50 wide. The sewage to be run into these and pumped therefrom into tanks in boats and conveyed to Long Island or New Jersey for irrigating and enriching the fields, or to some factory where it might be deodorized, and where the valuable matter might be extracted and converted into manure. It may be asked: Is the substance to be saved worth this labor? Will the benefit derived from it be equivalent to the labor and money which must be expended?

The Value of Sewage.—The great mass of our sewage is combined with water, so as to be in a very diluted state, perhaps more diluted than in any foreign city, as a greater amount of water is allowed per inhabitant here than in foreign cities. Liebig estimated that, with guano at £7 14s. per ton, one ton of London sewage was worth £1 8s. 4d. per ton, or at rate per head of inhabitants as 15s. 4d., thereby making 828 tons of sewage water equal to one ton of Peruvian guano. This estimate, however, has been proved to be too small. Hoffman estimates the solid matter derivable from sewage at £6 0s. 3d. per ton, and that the total sewage of London for the year 1868 was worth not less than £1,385,540. He further estimates 100 tons of liquid matter per inhabitant. The London commission to examine into the question of utilization of sewage reported that their practical experiments determined that enough was utilized to amount to 8s. 4d. per head of inhabitant. It is believed that the only value of sewage is from the fæces of the human and animal species as washed into the sewers. But there are other elements of value. Many of our streets are paved with granite. One of the principal constituents of granite is a mineral containing potash; from attrition of wheels and other causes this gradually wears away, and is swept off with the sewage water. The sewage water from the Oxford street, London, was found, by analysis, to contain 82.76 grains of potash to the gallon.

It has been urged that the diluted state of the manure in the sewage water is a reason why it should not be of value. Every farmer knows that manures which are too concentrated burn up his crop, though they are of great value when diluted. At the same time it is evident that the water before the sewage has a great part to act in carrying the suspended and dissolved matter into the earth. Dr. Welker estimates that twenty tons of stable manure contains: Ammonia, 530 lbs.; phosphoric acid, 200 lbs.; potash, 220 lbs. If this be distributed over one acre, and there is an average rain fall of twenty-six inches, he estimates that this would give in a gallon:

	Rain fall and sewage water.	London stable manure.
Ammonia	3.96 grains	7.02 grains
Phosphoric acid......................	2.40 grains	1.44 grains
Potash..........................	2.60 grains	1.63 grains

It may be asserted that the sewage will also have the rainfall. Calculated from average samples, it is found that the rainfall adds from the streets as much or more of solid as it does of solution. Let any one look at the filthy state of our streets before, and their cleanness after a hard rain, and he will acknowledge this, especially when he thinks of the amount of animal manure daily dropped on the streets which finds its way into the sewers with the rain. Experiments have been made in England and on the continent to concentrate or precipitate the valuable matter in the sewage, and some valuable results have been attained.

The Value of the Concentrated Sewage.—Thousands of dollars have been expended to deodorize sewage and at the same time precipitate all the matter held in suspension and solution. Various chemicals have been tried with varied success. Some have failed, some have proved too costly. The system adopted at Leamington has been determined to be the best, though it is not perfect. That system is called the A. B. C. system, from the names of the principal substances used. It there purifies two million gallons of sewage daily, at a cost of thirty shillings, and produces a manure which sells at £3 10s. per ton. The deodorizing mixture is made up as follows: alum, 100 parts; blood, one part; clay, 1,500 parts; magnesia, five parts; burnt clay, twenty-five parts; animal charcoal, forty-eight parts; vegetable charcoal, twenty parts. These substances are put into a tank with a certain quantity of sewage water, and agitated. It is then allowed to settle, and the water runs off perfectly clear and sweet, retaining only a slight salty taste. The settlings are taken out, put into a centrifugal dryer, then sprinkled with a little diluted sulphuric acid to fix the ammonia. The mass is then thoroughly dried and is ready for sale. Its color is that of black earth, and it has the smell of hot-house mold. Some English chemists have pronounced it better than guano. By analysis it contains: Water, 14.7; organic matter, 22.4; phosphate of lime, 9.6; earthy and alkaline solids, 11.2; insoluble silica, 42.7; nitrogen, 4.22. The operators of the works state that they get 1,600 weight from every 100,000 gallons of sewage water, and about five tons per day, and that they sell all they can make readily at the price above stated. Such has been the success at Leamington that other towns have adopted the same system.

It was proposed to carry London sewage to 50,000 acres of sandy marshes which lie to the north-east of the Thames and London, but the company failed for want of money and public confidence. They got so far, however, as to carry it to a model farm of 220 acres, east of Barking, where they have fully demonstrated the value of sewage water as a manure. It is estimated that the great northern sewage system of London throws into the Thames 32,743,000 gallons of sewage water per day. It is held back by reservoirs until the tide begins to ebb; then let out, in two hours the reservoirs are empty.

Effect of Sewage on Various Crops.—At Groydon, Edinburgh, and at twenty-four other places, this manure has been tried on hay and the various root crops with great success. At Bugby an experiment was tried as follows: Certain acres of the same character of soil were laid off in three parcels. On the first no sewage was put; on the second it was strewed at the rate of 3,000 tons to the acre; on the third, at the rate of 6,000 tons to the acre. The results were; From the first, three tons of hay to the acre; from the second, five tons; and from the third, five tons and fifteen hundred weight. Another experiment with 9,000 tons of sewage to the acre gave six tons 900 weight of hay. Liebig states that if soil is poor it will take 2,430 tons of sewage to produce four tons of hay; if soil rich in potash, 1,225. At Croydon the grass crop from the Sewage farm returns a profit of six shillings per head of the population who use the sewers. Italian rye grass seems to be the sole grass produced; mangel-wurtzel and other beets, and various garden vegetables, grow and thrive. The market gardens around Paris are also using the sewage water, and it has long been used at Hamburg and Munich. Great objection was first made from the supposition that there would be a strong offensive smell, but it has been repeatedly stated that this is not the case, the earth acting as a defecator, as in the earth closet.

Mode of Using Sewage.—Liquid sewage, when poured upon land, filters through the soil and runs off in drains, leaving its valuable matter behind. Hence land on which it may be used must be thoroughly underdrained. It may have a slight grade, but the ditch and sub-drainage is absolutely necessary. In England, several methods are adopted for putting it on the land. One advocates and uses open-drained ditches, from which he lets it flow over his fields in small streams, and another uses large tanks. Either is said to answer well, giving forth no offensive smell, and leaving the soil no more moist than an ordinary shower. The English sometimes put as much as 9,000 tons of sewage water on an acre. Every farmer knows that a liquid manure is more effective than a solid one, and that solids are valuable and effective according to the amount of soluble matter contained in them. The use of the sewage water, therefore, would seem to be the best mode whereby our farmers could derive benefit from the city's drainage. In the precipitation almost all valuable solid elements would remain, but some previously in solution would be lost or rendered partially insoluble. The application of the water, however, requires much carriage and a vast system of tankage, and for use it might be considered at least inconvenient. Those who have given the subject attention, however, are of the opinion that many of the New

Jersey and Long Island marshes and sandy plains might be reclaimed and rendered fertile by the use of it.

The Waste.—In these great cities of New York, Brooklyn and Jersey City, *at least* $1,500,000 worth of matter is yearly thrown away, which if saved would add to the health of the city, tend to cheapen the vegetables we eat, and give a new value to the lands surrounding the city.

In the proposed docks and piers there seems to exist an opportunity for putting a stop to the present waste. The saving in Europe is estimated at $1.50 (gold) per head of inhabitants, and even higher when the liquid is used. If the value of the sewage derived from the 2,000,000 of people in New York and the cities immediately surrounding it is placed at the moderate value of $1,500,000, we estimate that the values accruing to other property, that the increased health, and the inducements for a larger population, all which arise from a perfect system of sewage, would be still greater. An old philosopher said that nothing is lost in the eternity of things, but in this limited sphere it seems as if a thing is as good as lost when it is thrown into the sea.

WHAT THE CLUB HAS ACCOMPLISHED IN A TWELVE-MONTH.

In compliance with his custom at the close of the year, the Chairman made some remarks appropriate to the occasion. We are, he said, again reminded by this assembling on the last Tuesday of December that our work for 1870 is done. As a Club I feel warranted in saying that we have done more, and I believe better, work than any year before. Our influence as a Club is acknowledged in the most complimentary manner in thousands of letters received from, I think I can say truthfully, every State and territory of the United States. Formerly we sent committees from this Club to gather facts and information on particular or general matters of interest to Westchester, Kings, Queens, and rarely as far a Dutchess counties, in this State, and to a few counties near us in New Jersey. Then we sent committees to more remote counties in New Jersey, and into Pennsylvania and Connecticut. But during the year now brought to a close committees from this Club have visited Virginia, North Carolina, Georgia and Florida, Ohio, Tennessee, Kansas, Colorado, Utah and California. They have looked at Salt Lake, washed their hands in the Sacramento, and bathed their feet in the Pacific. From all these places they returned in safety, laden with a vast amount of most valuable information, as you are well aware, and the report, especially, made by individual members of the California committee, each for himself, was thus made at the request of your President. I hope and expect we shall have the pleasure of hearing more from that committee, and I did hope by this day Mr. Crandall would read his report as one of that committee. The Club has distributed, through the liberality of its friends, thousands of papers of flower seeds, and many letters of thanks from mothers and daughters residing in new homes, on new lands, far from us, far from their former home comforts, have been received.

Cereals for seed, new and very superior varieties of potatoes from Mr. Breese of Brandon, Vt., and grafts of choice fruit trees, strawberry plants, raspberry plants and grape-vines were also distributed. But time would fail me to enumerate the half, and I must pass over all in relation to agricultural implements tested; and as the State publishes largely our transactions in the annual report of the American Institute, it is through that source spread before the public, and the gentlemen of the press who so regularly attend and each week publish our proceedings, thereby doing a vast amount of good, for which I hope they and those they are connected with will reap a rich reward. As individuals we have a work to do quite as important, and, I think, a more direct accountability than when we act collectively or as a club. I should, perhaps, close, and say no more; but I must crave your indulgence for a moment or two longer, and in parliamentary bodies would probably be classed as rising to speak to a privileged question. I wish to thank the members of the Club for the uniform courtesy and kindness with which they have ever treated your presiding officer. Also, I wish especially to tender my thanks to the newspaper and agricultural press for the correctness of the record of our doings as published by them, and whose representatives meet with us as regularly as the Tuesday arrives. Also, I cannot fail to remember those women who are with us each week, helping by their presence your president to so easily preserve order and decorum. And, finally, let us now, at this close of the year, resolve each for himself or herself that henceforth we will live useful lives, doing good as we have opportunity, lubricate the steps of all that are in the right, and by precept and by example so teach that those we influence may be made wiser and happier, and at last may we meet as a Club in the garden of the Lord and enjoy the fruits of a well-spent life. We are ever sowing. Let us look well to the seed, remembering that whatsoever we sow *that* shall we also reap.

Adjourned.

January 3, 1871.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Which Breed of Hogs is Best.

Mr. Conrad Wilson, Springvale, N. Y., was the anxious inquirer. He would know the relative merits of Suffolk and the Chester White.

The Chairman.—I don't know that any of us are better informed in the lore of swine than Mr. F. D. Curtis, Vice-President of the New York Agricultural Society, and I will call upon him to make full answer.

Mr. F. D. Curtis.—If I should tell you exactly what I thought I should say the best breed was my own, the Victoria. The most fashionable breed to-day is the Berkshire. They are smaller and better hogs than the old Berkshires that were so strongly recommended when I was a boy, and which in a few years disappeared. The imperial breed are finer hogs and earlier to mature, but the objection is the color, black and white. When cleaned the skin is discolored more or less. They are easy keepers, and being extensively advertised sell at high prices. The Essex is a compact, round, plump little breed, black as a coal, and the quickest to get their full growth (about 300 pounds) of any kind. Mr. Joseph Harris, Rochester, is the largest breeder of them, and he can write a chapter in their praise at shortest notice. The Yorkshire is the base of all improved white breeds, and they are excellent hogs of a large size. The old-fashioned Suffolk had too much China and were too small and chunked. There is a breed called Suffolk which are small Yorkshires, but they are not common. Then there is still another Suffolk called improved, which has been imported and bred quite extensively by the Messrs. Stickney. It is a popular breed in England, and they are longer in the body, have more hair, and are yellowish white in color. They are a superior kind to cross upon common hogs, and would improve any native swine. Their heads should be small; ears the same. There is very little souse about them. The Chester White would doubtless improve the hogs of some sections. As this breed generally runs, the native hogs would have to be pretty mean ones to be benefited by a cross with the much lauded Chesters. They are coarse, lop-eared, big eaters and badly mixed. They are white, generally, always should be, and have the redeeming quality of being good milkers, and consequently good mothers. The old-fashioned, small Suffolk would probably be better by crossing with them, as greater size would be obtainable, and larger and more vigorous growth. There is more humbug about Chester

White hogs than any other breed. A very popular kind of hogs now-a-days is the so-called Cheshire, originating in Jefferson county, N. Y. The best breeders of these pigs are now very properly abandoning this fictitious title, and call them the Jefferson county swine, which is more appropriate. They have been bred too close and now lack bone and constitution, which defect can be readily remedied. The pigs often die in the west at birth, not having strength to help themselves, and their tails dry up and drop off, owing to a want of circulation. They are valuable to cross upon native hogs, and their offspring will usually be equal to the improved stock in looks, and possessing more stamina, feed better, and make more valuable porkers, *i. e.*, the breeder gets a finer tone and quality of meat, with less offal, and the constitutional vigor to develop the whole to a complete success. With coarse slab-sided squealers, a cross on the Jefferson county, would be just the thing. The change would be immense. I think these hogs have been bred long enough to merit the distinction of being called a *breed.* The western people believe in big things, hence they have a breed of their own started in Butler county, Ohio. They look to me like the old-time Berkshire, only a little more so. With the small farmer of the east, where corn is corn, they will not pay. Out west where transportation is an object, and it pays to crowd a good many bushels of corn into one hog and then into a barrel, these large-boned, big porkers will be profitable. They do not mature early enough for us. In middle Jersey they have a copper-colored hog that is remarkably free of diseases, and can turn corn into pork about as fast as anything that eats. It is a mistaken idea that the "swill-pail makes the breed." There is such a thing as economy of food in swine, and aptness to fatten, and all the imported breeds excel in these qualities over the native. They are superior also in regard to waste. It costs just as much to produce snout, ears and legs, as it does side pork or ham; hence pigs which have less snout and more ham, less ears and more length and depth of sides, less legs and wider shoulders, are to be preferred. There is also a mighty difference in the skin and the grain of the meat. The thorough-bred hog has a thin skin and fine grained flesh. Some of the western pork is not fit to eat, it is so coarse grained and flabby, and rank in taste. There is nothing which will pay the farmer better than a good breed of hogs, if not a pure breed, then a judicious crossing of such as he has upon a better.

Mr. D. C. Andrews, Woodbury N. J.—Now, we of Gloucester county, N. J., know nothing of Mr. Curtis's Victoria breed of hogs, but we have a breed here called Sandy, or red breed, that we think a great deal of and much superior to any Chester Whites. If they are taken pains with and bred right you seldom see them but one color, and that about a copper color. One great advantage they have over a white hog, they never mange. Mr. J. K. Lippincott, living near Woodstown, N. J., a few miles below me, killed on December 13, 1870 (and you know that is quite early to kill a pen of good hogs), nineteen hogs of this breed whose weights were as follows: 552, 530, 525, 507, 500, 441, 481, 432, 422, 391, 495, 427, 424, 367, 489, 449, 467, 484, 398, an average of 462 pounds apiece, nine of which were sows, and had raised sixty-five pigs, worth ten dollars per head, making $650 for pigs, 8,781 pounds of pork, at nine and one-half cents per pound, $831.19, $1,481.19, making a pretty good pen of hogs for the time of year.

Fertilizers.

Mr. A. St. Arnaud, Waverly, Pa.—Suppose I have a few tons of hay to spare, and as they cannot be fed with any chance of profit, will it not be better to buy with the overplus of my fodder concentrated manure, guano or some other, and trust the benefit of it to ensuing crops?

Dr. F. M. Hexamer.—There is no manure cheaper than that from the barn-yard. Still, in a season when hay brings twenty-five dollars a ton, as it does now, I would be disposed to sell; and next year, if it is ten or twelve dollars, I would buy enough to more than make up the loss. This would be better policy than to purchase commercial manures now. All commercial manures, so far as my experience goes, cost more than they come to.

Mr. John Crane.—If I am short of fodder I prefer to buy some concentrated feed, as cotton-seed cake rather than hay even at fifteen dollars per ton. I disagree with Dr. Hexamer, and I think I have frequently been benefited very much by the use of commercial fertilizers. At least they act quick if they are not permanent in effect.

Mr. A. S. Fuller.—I have tried most all sorts of manures, and I had rather have barn-yard manure load for load than half the stuff sold in the markets. I would pay thirty dollars per ton for hay rather than patronize the dealers in these delusive mixtures. Solon Robinson used to say here that it wouldn't pay to draw barn-yard manure a mile if you get it for nothing. It pays me to draw it by the car load thirty miles.

Dr. F. M. Hexamer.—I have been much impressed with the value of leaves for bedding as compared with straw. I am able to get delivered at one dollar a load of the farmer, large as a team can draw, and they are worth as much in the stalls, and make as good manure as five dollars invested in straw. Mr. Ely said he used to use leaves largely for this purpose, but that he has discarded them for the reason that horses slip in them, and are apt to do themselves harm in consequence. He thought the pig-pen the proper place for foliage. On a smooth plank floor this may be a slight objection; but on clay concrete there is no difficulty. It is mainly with my cows, oxen, and pigs that I use leaves.

APRICOTS.

Mr. S. Gross of Vineland, New Jersey, would know many things in reference to the apricot, whether they will bring good prices, how it would do to put pigs and poultry among the trees, etc.

Mr. A. S. Fuller.—Apricots are quite certain to bring a good price at all times, because there are few engaged in raising them, and the competition is not likely to be sharp.

Mr. John Crane.—I would graft on peach roots. My experience is that the trees thus obtained last twice as long provided the junction is very low. I had one twenty-one years old. Poultry would do no harm, but better keep pigs out till trees are well grown.

Dr. Isaac P. Trimble.—It would be a hazardous thing to advise the planting of an acre with apricot and plum trees if the pigs and poultry were to be depended upon exclusively for securing the crops of fruit from insects. The jarring process would have to be resorted to, as the fruit growers of Vineland well know. Apricot and plum trees in limited numbers can be found in most nurseries, especially along the North river. The apricot flourishes in Persia, Italy, and parts of Germany and France, best in mountain regions. It usually blossoms a week or ten days earlier than our other fruits, and is thus more liable to be killed with late frosts. If planted on the western slope of a high hill or mountain, it is greatly secured against such frosts. A hill side that will keep off the morning sunshine from striking the frosted blossoms will often save, the frost in the meantime evaporating. So few apricots are now cultivated on account of the curculio that it is hardly known in our markets.

DAIRY STOCK.

Mr. R. C. Jennings, Buffalo, N. Y., asked advice as to the breed of cows he had better purchase.

Mr. J. B. Lyman.—The most successful dairymen are those who buy cows with references to milking qualities more than to blood. It depends whether our correspondent wants butter or cheese. If for butter, I would advise him to buy one or more Alderney for the sake of the yellow tinge they give to the butter. For cheese the Ayrshire is doubtless to be preferred, for the reason that she gives more milk for the feed consumed, and for the additional reason that the cheese-making element is about the same in the milk of all animals.

Mr. Townsend.—I have bred most all kinds of animals and was best satisfied with the Ayrshire. I had one which gave sixty-eight and three-fourths pounds of butter in the month of March. Of course she was well fed. I would advise him to buy from the milking families of the Short-horns, and serve with an Ayrshire bull, breeding always toward the pail and away from the stall.

Mr. F. D. Curtis.—The Ayrshire has been bred for 200 years with special references to the milk-pail, and she is unquestionably best for either butter or cheese. I have tested Alderney and Ayrshire together, and have never been able to detect difference in the quantity of cream, though there is a difference in point of color in favor of the former.

Dr. Isaac P. Trimble.—In the best dairies they are getting into the habit of keeping the Alderney, say two or three in a herd of fifteen, for the purpose of coloring the butter, and this is certainly better than using annatto.

Mr. A. S. Fuller.—Mr. Lyman's advice is sound. Let him get cows that are good milkers, no matter whether they are red, yellow, fawn-colored or white. Then, if butter is his bent, three or four Alderneys in a herd of twenty or thirty natives will give high color and firmness of grain.

Prize Pork Making.

Mr. J. H. Jenkins, Oskaloosa, Iowa, fed fourteen hogs last May and June on corn soaked two days in water before it was fed. They gained fourteen pounds live weight to the bushel of corn (counting seventy pounds on the cob for a bushel.) They had all the water, salt and coal-ashes they wanted, but no slop or grass.

Mr. W. H. Bettes, Randolph, Ohio.—My neighbor, Alfred Needham, gives the following figures of two pigs killed on the 8th inst.: The pigs of one month old weighed thirty-four pounds; at eight months and ten days old the two pigs weighed 840 pounds; one of them, when dressed, weighed 377 pounds, the other 330 pounds; the pigs were fed, from the time of first weighing until killed, on corn meal cooked and mixed with slops from the kitchen.

SOWING CABBAGE AND LETTUCE SEED.

Mr. P. T. Quinn.—Market gardeners in the vicinity of large cities always devote a large space in their cultivated grounds to the growth of early cabbages and lettuce.

The time of sowing the seed for their early varieties, in the northern and middle States, is from the 1st to the 15th of September in the open ground.

Before sowing, the seed should be well worked over, and made fine and mellow by two or three workings. The surface may then be raked over, removing any stones, lumps of hard earth, etc. Then open drills one foot apart and one inch deep. In these drills the seed may be strewn by hand and covered by raking the bed over with a wooden rake, drawing the rake in the direction of the drills. The varieties of cabbage planted for early use by the market gardeners depends somewhat on their locality. The Early Wakefield and Early Winningstadt are at present the most popular among gardeners around New York. These two hold about equal rank for size, quality and uniformity of growth. The next in importance is the Early Flat Dutch, ripening about two weeks latter than the two kinds mentioned. The Dutch is a larger cabbage, with a flat, solid head and of excellent quality, and generally heads well.

There are only two kinds of lettuce popular with gardeners around New York. The first is a smooth-leaved, head lettuce, sometimes called "butter" lettuce. This variety is the best for forcing with bottom heat. The other sort is a curled leaf, and is known as "Simpson's" lettuce. This kind is planted largely in the spring between the rows of early cabbages. It is a tender variety of good quality, and grows to a large head. About six weeks from the time of sowing the seed, the plants of the cabbage and lettuce will be large enough to transplant into "cold frames," where they are kept during winter. These frames are made of rough boards, with crossties every three feet, and when cold weather sets in the plants are protected by sashes. There is very little trouble in keeping the plants in good order, and early in April they are hardy enough to set in the open ground.

SALT AS A FERTILIZER.

Professor James A. Whitney read the following paper: No fertilizer has given such contradictory results as common salt. On sandy soil, especially in the growth of mangold-wurtzel, it has so often given a marvelous increase of the crop that under these conditions its use has become a common and very profitable practice in England. On the other hand, on stiff clay soils its effect is very slight, almost nothing in the growth of cereals, and on such soils and for such crops its employment is deprecated. As soda, the direct product of the decomposition of salt, is a minor mineral constituent in most land plants, the beneficial effects of salt, where such occur, are due rather to its chemical action in the soil rather than to its contribution directly to the nutrition of the plant. The chemical action just referred to lies, in the main, in the solvent power of salt upon silica, and hence the positive advantage known to result from its use upon silicious or sandy land. An example of this is given in Voelcker's experiments, one of the most notable of which was made on a soil showing by analysis a great preponderance of sand, a deficiency of lime, and the presence of only moderate quantities of soda and potash. The results of these trials, carried on simultaneously, were as follows, the crop in each case being mangolds: Without salt, 12 tons 2 cwt. 76 pounds; 200 pounds salt per acre, 18 tons 19 cwt. 32 pounds; increase from use of salt, 5 tons 14 cwt. 20 pounds; 300 pounds per acre gave 18 tons 4 cwt. 72 pounds, an increase of a little more than 5 tons. On the same soil 800 pounds of salt per acre gave 21 tons 18 cwt. 84 pounds, an increase of upward of 8 tons 14 cwt. as compared with that receiving no salt. This last named quantity, 8 cwt. per acre, is, however, about twice as much as it is commonly advisable to use.

With Swedish turnips, experiments made about ten years since developed results similar in kind, but less in degree, than even the ordinary farm practice in the helping of mangold crops with salt. For instance, Swedes manured with 300 pounds of salt per acre gave 15 tons 16¼ cwt., an increase of nearly 1 ton and 2 cwt. as compared with land not thus fertilized.

For wheat and other cereals salt has given less definite and less favorable results, except when mingled with nitrate of soda or other substance capable of producing ammonia by decomposition in the soil. "Salt alone," says Voelcker, speaking of the experiments made under the sanction of the Royal Agricultural Society in 1860, "produced hardly any increase in the yield of grain, and slightly diminished the yield of straw. Salt applied in any quantity to cereal crops and to grass land certainly does not increase the produce. Nitrate of soda alone gave not nearly so good result as the same quantity of nitrate mixed with twice its weight of salt. It should, therefore, be an invariable rule to mix nitrate of soda with salt when it is to be used as a top dressing." Nitrate of soda is a substance composed of nitric acid and soda, just as saltpetre is formed of nitric acid and potash. Its efficacy is due to this, that it provides a supply of nitrogen, which enters the plant in the form of ammonia (it is held by some in the form of nitric acid, but this is doubtful). It has been much used in England, but only to slight extent in this country; and for our farmers, a substitute must be found in some other highly nitrogenized fertilizing materials. A top dressing composed of night soil, intimately incorporated with three times its weight of rich mold and about five per cent of salt, would theoretically furnish a good medium for applying the salt to the best advantage. Equally good results may be anticipated from the mixture in the proportion of one to four of common salt and high grade poudrette or guano, always provided the soil contains a large per centage of sandy or silicious material.

English practice, from which most of our data on the subject is necessarily drawn, has given some very suggestive illustrations of the manner in which this fertilizer acts under unusual conditions. As previously noted, it does little or no good on stiff clays, as was shown by the experience of Mr. J. Hooker of Oaklands, Walton-on-Thames. This experimenter in 1852 sowed wheat on a stiffish clay, resting on a sandy subsoil, and at different periods of the season sowed in the aggregate 400 pounds of salt per acre. Four acres treated in this way gave seven sacks (?) and two bushels of first quality per acre; while ten acres of the same kind of land, not salted, yielded but five sacks to the acre of poor quality. In this instance the experimenter followed the most excellent plan of analyzing the ash of the straw to find to what extent the structural development of the latter had been helped by the greater absorption of silica. He found that the ash of the average straw on the salted land had eighty-three per cent of silica, while the ash of the best straw on the soil not salted showed the presence of but seventy-eight per cent of this mineral. As there can be no perfect head of grain without stiff and perfect straw, and no proper growth of straw without silica to impart strength, the agency of salt in promoting the yield of grain is evident. But in order that straw should be formed, the supply of ammonia, needed most when the green parts of the plant are forming, must be abundant. This is the *a priori* reason of the efficacy of mixtures of salt and ammoniacal or nitrogenized manures for top-dressing and the like. In the case just instanced it is more than likely that the surface soil was in good tilth, and enriched by previous manuring with ammoniated manures. The saline solution filtering to the sand below, this last accessible to the roots of the plants, dissolved the silica, so that the quantity available to the plants was in due proportion to the supply of other mineral constituents of plant nutrition. Another trial on land of a similar character, manured with about 120 pounds of salt to the acre, sown broadcast on the 12th of May, 1863, resulted in a yield of 2,475 pounds of wheat against 2,337 pounds on the unsalted soil—a gain of 138 pounds, or about two and three-quarter bushels per acre from the just named measure of salt.

While the benefits of salt are apparent on light soils, and to a certain extent on those of somewhat stiff texture resting upon a loose and silicious subsoil, the evidence is almost wholly against it when applied to lands known as heavy clays. This is partially due, without doubt, to the want of a sufficient quantity of silica to be acted upon by the solvent solution; but the difference between the results shown on the two kinds of soil is also founded upon another cause, the fact that light dry soils hasten plants rapidly through the different stages of growth, so that they often become prematurely ripe. From some cause not fully understood, or at all events not satisfactorily explained, salt, as is proved by practice, prolongs the several periods or stages of plant development, so that more time is afforded for the assimilation of other plant food, so that, supposing this other plant food to be present in sufficient quantities, the yield would be correspondingly prolonged. On the other hand, damp and heavy soils retard or lengthen the successive stages of development, leading to too late maturity, and calling for the application of ammoniacal manures to stimulate growth in the earlier stages, and phosphates to supply in abundance the requirements incident to the later ones. On grass, the retarding action of salt has the specific effect of checking the rank growth resulting from the presence of a large quantity of ammonia in the soil, which frequently gives a kind of coarseness to the fiber and flavor to the forage, the grass being for this reason sweeter when top-dressed with salt on rich land, and consequently more cleanly eaten by the cattle. This advantage, it must be mentioned, is in a measure counterbalanced by a diminished product by weight of grass or feed from a given area of ground.

The use of salt as a preventive for clubfoot in cabbage, is familiar, as is also its general failure for the purpose. Not so, however, the fact that this plant illustrates, perhaps better than any other, the manner in which salt is carried into the circulation of vegetables and the indirect way in which it is believed to principally contribute to their nourishment. For salt has the property of being absorbed by the roots of plants and of circulating throughout their vascular structure without being assimilated, or in other words, without combining with other substances in the formation of organic matter. To such an extent is this the case, that with cabbages grown on land heavily manured with the material, the salt has been found exuded and crystallized upon the leaves. Salt, as such, is claimed by eminent chemists to be always absent in all ripened seeds; but in bulbs like the mangold or sugar-beet it exists in large quantities. This detracts from the value of the beet for sugar manufacture, and when the same are fed to cattle does away, for the most part, with the necessity of feeding salt. Detriment to the inherent value of root crops grown on land unduly impregnated with saline material is not, it should be noted, peculiar to that impregnated with common salt, but is experienced also with soils charged with other sodic compounds. It is said that beets grown on the alkali soil of the Great Western Basin, and of certain districts of California, are almost wholly devoid of saccharine qualities owing to the amount of sodic solutions in them, and can be used only for cattle-feed. By growing beets on the same ground for two or three years, the soda is so far abstracted from the soil that it assumes the character of ordinary soil, and common crops can be grown upon it to advantage.

It will be seen from the above that salt is worth the most on light and sandy soils, and the least on stiff and heavy ones; that it should not be used in large quantities, seldom more than three cwt. to the acre, and very frequently less; that it lengthens the period of growth; that for cereals and on stiffish land it should be mixed with ammoniated manures, and that it often materially modifies the character of the product, as in rendering sugar-beets less saccharine and pasture grass more succulent. The practical application of these truths, the manner in which salt can be best applied alone and in combination with other manurial agents, and the relations of the same substance to the animal economy, are matters of much interest and importance.

Adjourned.

January 10, 1871.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Honor Due to Good Farmers.

Mr. Conrad Wilson, Spring Vale, N. Y.—I have been exceedingly interested in the report of your committee, a short time since, upon some improved methods adopted by Jersey farmers on the lower Delaware. The yield of potatoes and corn obtained by Clark Thompson is certainly remarkable, taken in connection with his method. But I do not see in it any argument against subsoiling as a rule. Nor yet am I able to perceive in the splendid ears of corn exhibited by David Petit, any reason why a three-inch furrow should be taken as the rule for corn, instead of the exception. It seems to me, sir, that the whole controversy as to how deep we shall plow, is simply a question of the soil, to be determined partly by its general character, and partly by its condition in each particular case. But setting aside this question, I cordially agree in your estimate of these intelligent men, and of the noble calling they adorn. There are not less than five or six millions of farmers in the United States, and among them are to be found some of the very highest types of manhood. The prosperity of the farmer has this peculiarity; it implies and carries with it the prosperity of the whole country. This is not true, to the same extent, of any other vocation; the man who carves out his fortune and wins a competence for his declining years by the culture of the soil, has thereby made himself the benefactor of his race. Nobody is the worse for his career, while many are improved and spurred onward by his practical wisdom, and by the healthy contagion of his example. When, therefore, your Club makes honorable mention of such model farmers as Hexamer, Thompson, Petit, Acton and Crane; when through the countless channels of your influence you applaud them to the ear of the whole country, it seems to me you are but rendering a just tribute to deserving men, and to the very numerous and respectable class they represent.

Paint for Houses.

Professor H. E. Colton, remarked that there is nothing so cheap in the long run as pure linseed oil and genuine white lead, but the trouble, he continued, is to get these articles pure. As to the lead, it is safe to say that wherever a firm puts its name on the cask or can, that that article is pure. Such is the custom of the trade. Though in no way connected with the business now, I have had five years experience in it. There is no other way for the farmer to tell except by a chemical analysis, as the article with which paints are adultered, called barytes, is nearly as heavy as white lead. As to linseed oil, when adulterated with fish oils, it may be detected by dropping a little on hot iron, it will soon give out a fishy smell. When adulterated with winter-pressed cotton-seed oil it cannot be detected by any ordinary means; with the common cotton-seed oil it chills in ordinary winter temperature. There are other paints on which firms put their names, as the various zincs and a new article called Bartlett lead. They are all pure of the kind labeled. The correspondent, no doubt, means to ask as to the various liquid paints offered for sale through the country. No pigment has yet been discovered, except this Bartlett lead, which would hold in solution when mixed with oil and spirits turpentine. Hence, nearly all these cheap liquid paints are combinations of oil and an alkali or acid water. Some of them contain about a pint of oil to the gallon, the rest being water and benzine. It is needless to say that such paints are worthless.

GROWING GINSENG.

Mr. J. S. Bean, Bowling Green, Ky., asked whether, in the opinion of the Club, it is possible to cultivate this plant with profit.

Mr. A. S. Fuller answered that there is no reason why it can't be produced easily on suitable soil. He didn't know anybody who had grown it as a crop, but thought it might pay to make the trial.

Prof. H. E. Colton said it grows in Tennessee and North Carolina, and in the north-west, and he casually mentioned that as a tonic for diseased stomach it is of great value. He knew a man who suffered terribly from dyspepsia to be entirely cured by chewing this herb; but care should be taken, as there are many plants going by the same name. Mr. A. A. Low of this city is the largest shipper of ginseng from this country. It all goes to China, where it is believed to be a panacea for all the ills of the flesh. The price has quadrupled within a few years, and the demand constantly increases.

HEDGE OF HOLLY.

The same writer asked how he had better proceed in order to secure a fine hedge of holly.

Mr. A. S. Fuller replied that he may plant the seeds.

Mr. Thomas Cavanagh advised him to buy the plants of a nurseryman, otherwise he will be an old man before his hedge gets any considerable growth.

To Keep Mice from Trees.

Mr. W. H. Randall, Ypsilanti, Mich., stated that he had tried most all remedies, but had found none so effectual in preventing trees being girdled as "to take a common-sized sheet of tin and cut into four equal parts, bend around a fork-handle and give the desired shape, and apply to the trunks. This makes a barrier that the mice cannot get over or around, and costs but a trifle."

Dr. F. M. Hexamer said it is easier and cheaper to bank up earth around the trees twelve or fifteen inches high. It is also well to tramp down the snow solid after each fall.

The Chairman remarked that another advantage in banking is that the water is thus prevented from standing about the tree roots in spring.

Borers.

In course of some remarks on the subject of Borers, Mr. Reed of Perth Amboy, stated that he had found it a great advantage to tie tarred paper close down about the trunk of the tree, and remove the same in September. He used the common roofing paper, which was already prepared, and cost but a trifle.

Mr. P. T. Quinn said this was well as far as it went, but that he had found borers as high up as the main branches, and that these must be followed with the knife.

Mr. A. S. Fuller.—The moth which produces the borer, by an unerring instinct, seeks to hide her eggs in the unexposed part of the body of the tree, and where the bark is thin; hence, if grass or weeds are left standing around the roots, she finds there a congenial field for observation and action, and there she works. Farmers often take more pains with a hill of corn growing under a tree, worth not more than three cents, hoeing it nicely, than with a tree worth ten dollars. Good, clean cultivation is the best preventive for borers, because it benefits the top as well as the bottom.

Chester White Pigs.

Mr. Herman Beach, Litchfield, Conn., gave an account of some Chester White shoats, fatted by Mr. A. G. Smith, of that town. They were of the Chester White breed, born the 6th of April, and butchered December 7, being then eight months and one day old. One weighed 430 pounds, the other 426. They were taken from the sow at six weeks old, and fed on whey and one quart of meal per day apiece, and increased the meal at six or seven months old up to twelve quarts per day apiece, but the last month they did not eat but eight quarts per day apiece.

HOW TO APPLY PLASTER.

Mr. W. M. Tomlinson, North Urbana, N. Y., asked the members of the Club to reconcile the difference of opinion which prevails as to the proper way of sowing plaster with grain crops, some choosing to drill it in with the seed, while others prefer to scatter on the surface, after the seed is sown. "It is claimed that, by putting it in with the seed, it helps the crop from the outset, giving a start which keeps it ahead of surface-plastered crops. On the other hand, it is argued that, as the principal gain in the use of plaster is derived from the atmosphere, surface application best secures this, and, hence, is to be preferred. What says practical science? Would the answer vary with different soils?"

Mr. F. D. Curtis.—As plaster is an absorbent of ammonia, it is better to sow it on the crop, and let the rains following wash it down to the roots. This is a gain to the plant, for, if first put into the ground, it will absorb the ammonia in the soil which is already there, or it must wait for exposure to the surface to do its full duty, which exposure might not take place until the next crop. Plaster does but little good on wet ground, and its benefits vary considerably one season with another. Sometimes its effects are almost marvelous, and then again they cannot be seen. On dry loam or gravelly soil, sown on clover it often doubles the crop. In Glenville, N. Y., lands rejected fifty years ago as worthless, now by using clover and plaster are worth $100 and $150 per acre. Sow plasture on the manure heap and in the hen-houses.

KEEPING PLANTS IN THE CELLAR.

A lady correspondent from Elizabeth, N. J., writes as follows about protecting tender plants during winter:

"It may interest some to know how those who cannot afford the luxury of a green-house can keep their tender plants all winter. My cellar is dry, cool, and dark. About the first of November I have the orange, lemon, petersporum, and oleanders carried into the cellar. These are all in large tubs, except the latter, which I have placed in one when taken in, and then the roots covered up with soil. These plants are watered once a week, while they are in the cellar, with tepid water, and they keep in fine order. In the spring the foliage looks fresh and green. The scarlet geraniums we have taken up with a spade, the earth shaken from the roots, and the geraniums tied in bundles of five or six together, and then fastened to the beams of the cellar, without further protection. In April they looked wilted, but, when transplanted into the open air, they soon recover and grow luxuriantly. I have been very successful in growing the scarlet salvia from seed sown in pots in February, and then placed in a room facing east, where the temperature is even, but low. They are transplanted in beds in the garden in May, and with me they always grow and blossom luxuriantly until frost. The climbing cobea I have taken up in the fall, and transplanted into a large eight inch pot, and then placed in this room. I water it freely when first taken up. Last winter this vine grew finely, covering one side of the room with its beautiful and delicate foliage."

How to Save Egg-plant Seed.

Mr. P. T. Quinn.—The careful gardener will always make it a rule to select from his crop a few specimens, the most perfect of their kind, for seed, for the following year. When this plan is faithfully carried out, there is no trouble with such kind of home-saved seed not coming up under ordinary circumstances; and when it does come up, the variety is sure to be true to name; which is not always the case when the seeds are bought from venders or irresponsible seedsmen. There is nothing more vexatious in the gardener's legitimate routine of business than to make all necessary preparations for seeds, preparing the ground with care, manuring, etc., and then find out, after it is too late to make a second attempt, that the seed is old, and will not germinate, or that, instead of cauliflower, the plants are mixed varieties of cabbage.

Egg-plant seed is one of the most difficult to start in the hot-bed; and to insure an abundance and strong plants, fresh seed should always be sown, and even then it sometimes fails to germinate.

The largest and best formed eggs should be selected for seed, and in separating the seed from the flesh requires some skill and care.

For doing this work select a bright, clear day, and begin the work early in the morning, so that the seed can be separated and partly dried before the sun goes down; if not, the whole lot may be rendered worthless by sprouting during the night.

Although hard to start in the hot-bed, when first washed out from the eggs, it sprouts more easily than any other kind of garden seed. I have had large quantities at different times spoiled in this way in a single night.

The eggs should first be peeled, and then the part of the stem end, that contains no seeds, be cut off. The balance is then cut in small pieces and thrown into a tub or pail of water. Each of these pieces are then taken in the hand and tightly squeezed, which displaces the seed from the flesh; and when all the seed is separated in this way, the pulp part is thrown away. The good seed will settle to the bottom of the vessel, and, by slowly spilling the water from one tub to another, all the extraneous matter can easily be removed, leaving the seed clean. Before passing the water from tub to tub it may sometimes be found necessary to rub between the hands the portion of the pulp that the seeds adhere to. This is separated from the seed by pouring the contents of the vessel through a sieve, with a mesh large enough for the seed to pass through, while it holds a large part of the pulp.

When the seed is freed from this pulp, it should at once be placed on a fine sieve, or a board with a smooth surface, spread thinly and placed in the sun to dry. The seed should be stirred frequently during the day, say every half hour, so that the surface of the seed will be hardened enough not to sprout during the night. It will require a couple of days' exposure to dry the seed, and, when dry enough, it should be put in a bag and hung up in a garret or seed-room until wanted.

Adjourned.

January 17, 1871.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

SPROUTING SWEET POTATOES.

Mr. William Alexander, Austin, Mo.—I would like to put out 15,000 sweet potato plants next season. Will the Club inform me of the process to produce them?

Dr. F. M. Hexamer.—Cut the potatoes in two lengthwise, and place them in a hot-bed. Remove the sprouts as fast as they are large enough, and put them in small pots in a cold frame. Fresh sprouts will appear on the old pieces, and the repetition will go on till the vitality of the tuber is exhausted. The bed should not be kept too hot, or the sprouts will be weak and worthless. For facts in regard to the construction of hot-house, cold frame, etc., he should see some work treating of that subject.

Mr. V. D. Van Nest, Hightstown, N. J., offered the following as his process: First, make a frame of boards if the ground be cold or heavy on the surface; if light or sandy, dig out to the depth of eight to twelve inches from the bottom of the bed to the top of the frame in front, and twenty-six or twenty-eight for back, to give a good slope or water shed four and a half to five feet from front to back. Take good fresh stable manure and coarse hay, bog hay is best; first a layer of hay, then manure, then repeat; pack it well to one foot in depth, wet it slightly, cover with three inches of sandy loam, lay in the potatoes; if small, whole, if large, cut in two from end to end, with cut side down; cover with one and a half inch of light sand loam. Leave so till the potatoes begin to sprout, then cover with the same to three inches, to insure good and plenty of fibrous roots. When the plants are three inches high they are ready to transplant to the hills or rows for growing. I use no water, puddling or plaster in transplanting, and lose but few plants. Use glass or sash, to give a quicker growth to the plants, as I find such worth more than those grown without; keep the temperature in the frame from seventy-five to ninety, if possible. I make my hot-beds from the 10th to the 20th of April, according to the season. I get from 10,000 to 15,000 plants per barrel of seed.

HOLLOW HORN IN CATTLE.

Mr. V. D. Van Nest, Hightstown, N. J., begged to recommend "a better plan than boring. Apply spirits of turpentine, ten or fifteen drops, to the roots of each horn, rubbing well with the hand from one horn to the other. Have known old cows, when they have had plenty to eat, to get down with this disease, and one application would restore them to health."

Mr. F. D. Curtis.—I lack faith in the prescription, and I also think the use of the gimlet pure cruelty. I would nurse the animal, put in warm stable, and feed well.

Mr. John Crane.—I am of opinion that a little excitement is a good thing, and I approve of hartshorn in certain instances, because it produces this effect. There is efficacy in salt pork in case of sick cattle. My father saved several which were too weak to rise, by giving salt pork cut in thin slices, say two pounds in the space of four or five days.

Mr. E. Williams.—Hollow horn comes in connection with a depressed condition of the system, and hartshorn is good, because it increases circulation and gives the animal strength.

ALDEN'S PROCESS FOR PRESERVING FRUITS AND VEGETABLES.

Mr. Charles Alden, Newburgh, N. Y., who has made the preservation and utilizing of all fruits a special study for twenty years, was introduced by the chairman, and made the following statements: Some time last spring I appeared before you and made a few general remarks in regard to my new process for evaporating water from fruits, vegetables and animal substances rapidly, cheaply, and so perfect that the original taste, flavor and color are retained, and will keep in any climate. Since then my evaporators have been put up in a neighboring county, where they were in successful operation some three months, giving the best satisfaction to the enterprising owner and all concerned. Large quantities of the apples, etc., put up by this process may be seen at the ware-rooms of the Alden Fruit Preserving Company, No. 123 Chambers street, New York city. Pies made from these evaporated apples, pumpkins and currants, do not require half the sugar necessary to use with the fresh fruit. I have passed whole apples with the skin on through the evaporator in two hours, and when taken out they had the same appearance as when put in, full and plump; but on breaking the skin the inside was found to be soft all through, much like stewed apple-sauce, only very much sweeter. This seems to hold good in all fruits and vegetables subjected to this treatment. I can only compare the process to nature's laws in ripening fruits. The apple, pear, and peach, when first formed, are very bitter, with little or no acid, but as the season advances the fruit becomes more developed and very acid, losing nearly all that bitter taste. As the air becomes warmer and more humid, the fruit in its development loses nearly all that acid and bitter taste, and in its place we find the saccharine matter, and then the mucus, which gives to the pear and peach that particularly luscious and juicy taste. To hasten the operation of nature in ripening the fruit, I have seen that well-known veteran fruiterer, Charles Downing, at his home in Newburgh, pick his choice pears and apples and put them in a dark room in his office, away from the rays of the sun and chilly night air, both detrimental to the perfect and speedy maturing of all fruits. When a boy I used to hook apples and pears and put them in the hay-mow, there to ripen quicker and better than on the tree, but I could not then tell why they would thus ripen quicker. By this new process, all refuse and unmarketable fruits, windfalls, cores and skins of the apple, the skins of the peach, etc., can be preserved and used for food for man, and made as profitable as the best and fairest; also, all kinds of berries and small fruits, from which I make the finest and most delicious jellies, marmalade, and extracts. This can be done at any time, without regard to season or weather, retaining all the taste, color and flavor of the original fruits.

The evaporated onions, pumpkins, cabbage, asparagus, sweet corn, and sweet potatoes, have just the same taste, when cooked, as the fresh vegetables. This has not been the work and thought of a day or a week, but over twenty years of study, experiments, close application, and practical hard work. Thousands of fruit-growers and farmers, spread over every State in our Union, are looking to the Farmers' Club of New York for information on the subject of preserving their fruits; and if one-half I tell you is true, you will admit it is a wonderful discovery, and worth millions upon millions to the country. I will take a wagon-load or one ton of pumpkins, evaporate them in a few hours, and press the whole into a flour barrel, which can be sent to any part of the world, and from which the most delicious pumpkin pies can be made. I can exhaust the entire strength of one bushel of apples, after being evaporated, and make it into three pounds of the most delicious jelly, without the addition of sugar or anything else, and without boiling, at trifling expense, worth at least one dollar per pound. From one bushel of sweet potatoes, after being evaporated, I make over one gallon of the richest and most delicious syrup, weighing eleven pounds to the gallon, and ten pounds of an excellent quality of flour. The syrup is worth one dollar and thirty-five cents, and the flour thirty cents; one dollar and sixty-five cents from one bushel, which will cost about sixty cents, over one dollar gain from a bushel of sweet potatoes at present prices in this market. I have more to say at another time, and through you, to all the fruit-growers, of what can be done with the evaporated berries of all kinds; also, grapes, cherries, plums, and figs.

Mr. Alden then proceeded to cite figures going to show that, with an evaporator with capacity of 500 bushels of fruit per week, and costing about $2,500, a man may realize a profit of $363 on each 500 bushels of apples, $402 on the same weight of pumpkins, and $548 on 360 bushels of sweet potatoes.

The Chairman.—This syrup is certainly very fine. If I had not been told it was made from sweet potatoes, I should have pronounced it sorghum, well cooked. If the half is true which is claimed for the process described, it is an important discovery. After a while, I purpose appointing a committee to investigate.

Mr. Alden.—A thorough examination into the merits of the subject is what we especially desire. We feel sure nothing else could so effectually establish the justice of our claims.

SYSTEMATIC OBSERVATIONS IN AGRICULTURE.

The committee to which the paper of Prof. Andre Poey was referred report, that they have carefully considered the suggestions of this observer of the science of meteorology, and find that his system, or method, is based upon the following facts: The growth of the plants most useful to man depends upon certain substances in the soil, and also upon conditions of light, warmth, moisture, and winds. The attention of farmers has been turned wholly upon the composition and enrichment of soils, and the study of the other conditions have been disregarded. While control of influences above the soil is not deemed possible, he thinks great advances can be made in a modification of light, in a knowledge of what the weather is to be, and in a positive determination of the amount of warmth necessary to grow and ripen all the important crops. The practical steps which Prof. Poey recommends to the agricultural reformers of the country are as follows:

1. Chairs of meteorology in all the State agricultural colleges. The association of all the agricultural colleges in the United States for the purpose of supporting a series of annual lectures, to be delivered by the same professor, to insure uniformity of theoretical doctrine, and, more especially, of experimental method. These lectures will be improved every year by the exposition of the new discoveries in the science.

2. The creation by government of a body of State observers in each region of the country. The duty of such State observers should be to collect and control all the meteorological observations appertaining to his own State, so as to settle the special laws regulating the climatic conditions of each State, in order to be able to determine the general laws of the whole climate of the United States, and, after careful discussion, to apply these observations to vegetable growth, and to furnish to farmers only such results as would be most useful to them. An annual report should be published for the benefit of agriculture and general science.

3. The government should establish an experimental field, where all the physical and chemical agents of the soil and atmosphere, which exert any influence on vegetation, could be submitted to profound studies and repeated experiments, with a view of discovering the laws regulating the vegetable organism. In this field, all the diseases of plants known under the generic name of fungi, which occasion annu-

ally a loss of millions of dollars to agriculture, would be also submitted to experimental researches in order to discover the origin of these pathological affections, the means of destroying them, and of preventing their return. This capital question in agriculture suffices in itself to show the immense utility of such an experimental field, the cost of which would be largely returned in increased production. In this way the United States will enter on a grand scale the path inaugurated in 1822 by the celebrated horticultural society of Cheswick, in England. Although its researches were limited to the application of meteorological observations to agriculture, at a time when this science was making its first appearance, many advantages have been drawn from its conclusions.

4. The government has just established a net-work of maritime stations, under the care of the war department, with the aim of forewarning mariners, by means of telegraphic signals, of the approach of tempests upon the sea-coast and lakes. Many years before, the Smithsonian Institution, under the wise control of its secretary, Prof. Joseph Henry, had established a different net-work of observers for the study of the climate of the United States. Neither of these series of observations have, nor can have at present, but a very limited and indirect application to agriculture. The process to be pursued is the following: The day and hour at which the seed is sown must be marked, together with the prevailing temperature; the maximum, mean and minimum temperature will be marked every day thereafter until the first symptom of vegetable life is shown, when the radicles appear and the plumules rise. Then, by adding up all the observed degrees of temperature in this first period, and by squaring the sum, we obtain, as nearly as possible, according to the number and carefulness of the observations, the exact degree of temperature which this or that seed requires to germinate. We proceed in the same way for the interval between germination and foliation, between the latter and blossoming, thence to fructification, and finally to leaf-falling or the hibernal sleep of the plant. If we repeat the same observations for the moisture, light, and other atmospheric agents which powerfully interfere in the vegetable organism, we obtain all the necessary conditions for its scientific culture and greatest production. Why? Because, when this or that function of the plant becomes paralyzed by the failure of something which we do not now know, we will recognize that it must have so many degrees more or less of heat or moisture. Instead of proceeding blindly, as has been hitherto done, in place of wasting time and fortune in fruitless attempts, one will advance

guided by the light of science, acting with almost the precision of mathematical accuracy. It is only after this first study, and not before, that the net-work of observations of the Smithsonian Institution, furnishing us the climatic conditions of the various localities, will be very useful to farmers wishing to locate and transplant their culture. Having already acquired a knowledge of the number of degrees of heat, moisture, etc., that this or that culture requires, in this or that climate, he will have no difficulty in judging of the conditions of new climates.

It is only then, moreover, that the network of the War Department will be doubly useful to them for sheltering their crops from atmospheric disturbances once their normal state is known. The precise degree of resistance to be opposed to the perturbation will be exactly known. Later, when vital perturbations are better appreciated, he will be able to foresee atmospheric disturbances, and *vice versa*. We now understand why meteorological observations in any way applicable to agriculture can be made only by farmers or by observers specially intrusted with this labor. We therefore make a general appeal to farmers to take at an early day these facts into consideration, and go to work as one man in the interests of agricultural science. 5. In order to discuss all the atmospheric observations and periodical phenomena of plants made by observers and farmers, a bureau of meteorology should be established in the Department of Agriculture. The investigation of French savans have proved a close connection between the barometric pressure, temperature, and moisture in the prevailing winds and storms as follows: That where the pressure is the highest the temperature of the air is the lowest, and *vice versa;* that the wind flows out in all directions from regions of higher pressure to those of lower; and that the moisture follows the track of the highest temperature. Now, the whole system of winds blows vertically in upon the spaces of low pressure, and this path is pursued by the center of cyclonic storms and hurricanes. We can see the application of this fact to agriculture. Suppose we knew the lines of equal mean monthly barometric pressure, temperature, moisture, and direction of the wind over the whole country, then, by tracing on the map all the stations where the lowest pressure prevails, we should ascertain the exact track which the storm had to follow, as the wind flows from the surrounding stations of the higher to those of the lower pressure. Weather previsions, as applied to agriculture and navigation, rest almost entirely upon this rule. But before reaching this point we must work up these monthly charts of the normal state of the atmosphere in order to foresee and trace the abnormal, just as in the human body we must know its healthy condition in order to cure disease.

Another question which the meteorogical bureau must take into consideration, and which shows again what an important bearing temperature has upon agriculture, is the following: Farmers in England believe that if the night temperature falls to forty degrees Fahrenheit, there is no growth for twenty-four hours, and that the mean temperature the following day might be expected to be about forty-six degrees. In this country a similar law must prevail, probably with different degrees of heat. Then, by observing the monthly charts and taking note of those parts of the country where temperatures were less than forty degrees, one would ascertain the places where during certain months there was little growth, a very important question in discussing the crops of the United States. The next useful temperature for agriculture is that required to ripen cereals. It has been proved by observations made by persons competing for prizes offered by the Marquis of Tweeddale, President of the Scottish Meteorological Society, that the ordinary range of temperature in Scotland must average fifty-six degrees Fahrenheit. If it fell below that there was a deficiency in the crop; if it rose the crop was so much the better, provided there were rain and other necessary conditions. In the same manner a thousand agricultural problems should be submitted to strict scientific and practical tests as to the influence of climate on our American crops. There is no book on climate in its relation to agriculture to which the American public has access. Such a volume cannot now be written, for want of groups of facts of sufficient extent and accuracy. Such facts cannot be collected by the enterprise and enthusiasm of one student however zealous. It must be the report of a scientific man, who has access to a great body of materials, and who possesses the art of stating results in a plain form for daily use.

Your committee consider that the above suggestions of Prof. Poey are entitled to careful consideration by the farmers of this country, and especially those who are shaping the policy and establishing the grades of our agricultural schools. We consider the subject of sufficient importance to recommend that Col. Capron communicate the plans of Prof. Poey to the presidents of these colleges, and urge them to provide for the careful study and accurate noting of meteorological facts in every part of the republic.

J. B. LYMAN,
CHAS. D. BRAGDORN,
Committee.

The report was accepted by the Club, and the Secretary instructed to communicate with the Department of Agriculture on the subject.

RIDDING LAND OF STUMPS.

Mr. W. G. Cornstock, East Hartford, Conn., wrote that when in the north-west recently, he was told of the practice in the Superior region: "In the fall bore an inch, or an inch and a quarter hole, according to the size of the stump, *vertically* into the middle of the stump, eighteen inches deep and put into it an ounce to an ounce and a half of saltpeter; fill the hole with water and plug it up. In the spring take out the plug, and put into the hole half a gill to a gill of kerosene, and ignite it. It will go on burning without any blaze until the whole stump to the extremity of the roots is consumed, leaving nothing but ashes. The stump must be moist; an old dry stump will not be penetrated by the saltpeter.

The Chairman.—If it is true that stumps can be consumed so easily it is important. It may not be too late to prove it this winter.

WATER FOR COOLING MILK.

Mr. C. A. Williams, Waitsfield, Vt.—What is the cheapest and best way to utilize a bountiful stream of spring water which maintains a temperature of fifty-eight to sixty degrees during the hot weather, in a butter dairy? Shall I get all the cream if I set the milk in pails at a depth of twelve inches immersed in water to the same depth? Will the dampness arising from the water injure the quality of the cream.

Dr. Isaac P. Trimble.—Let our friend have no fear of cool water. It will do him good, and only good, and that continually. He will *not* get all the cream if he sets twelve inches, four is better.

He must keep his spring house clean and well ventilated. Mix a pail of thick whitewash, and when mold comes on the inside wall above the water, as it will wash the spots over. Cover the window holes with wirecloth, and have the surface all around the windows a clean sod. Put *nothing* in the milk room but milk cream, and butter. By observing these rules strictly, and bringing his cool water all around his milk pans, he can make, in dog days, butter as yellow as a dandelion and as firm as wax.

CORAL OR SHELL MARL FROM JERSEY.

Mr. Henry McKeage sent a box of it from a bed in New Egypt, N. J., and asked that the professor might put chemicals to it and find out how much it is worth to the farmer.

Prof. J. A. Whitney.—I find the deposit to be a mineral of peculiar porous and granulated structure, supposed to be the remains of a coral formation, and evidently mingled with matters deposited from solutions from neighboring upland. It is principally carbonate of lime, but contains considerable insoluble material. Calcined, it would be worth from one-half to two-thirds as much as ordinary lime. In its present form, it is best adapted for use on light, loose upland, on sandy soils where there is a deficiency of organic matter, and in garden soil where caustic lime would tend unduly to disengage ammonia from the rich mold. For such, I should estimate its commercial value at from one-fourth to one-half that of ordinary air-slaked lime. It would act more slowly than the latter, and therefore, on the soils just mentioned, and in the long run, more beneficially, but the effects would not be so apparent at once.

The Importance of Ventilating Bee-hives

Mr. Peter Cambell, Carrolltown, Pa.—Close observation and experimenting convince me that hives will be much healthier and freer from disease and rank smell to both bees and comb when well ventilated. In order to accomplish a thorough ventilation I have constructed a hive with a ventilator of tin running from bottom to top, of the box, at its center, having its four sides perforated with small holes through which the air passes into the comb and among the bees, and thence out at the top through a gauze wire. The bottom of the ventilator is also protected by gauze; and in cold weather both top and bottom can be closed up by small slides placed for the purpose. This improvement has been tried and found to work successfully. Another feature of my box worthy of mention is the arrangement by which I trap moth millers. I have an opening for them to enter at either side of the bee entrance, from which they make their way up inside the inner lining of the box, and are thence attracted by the light of the outer lining down, between the two linings, where they are easily seen and killed. The sides of the box are of glass, to be closed up by wooden shutters. By this arrangement the working of the bees can be seen at any time, and the quantity of honey in store as well as the amount of surplus honey is easily discovered; hence no danger, in taking away the surplus honey, of ignorantly robbing the hive too closely.

Adjourned.

January 24, 1871.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

FRESH MEATS FROM THE GREAT PLAINS.

Attention was called by Mr. J. B. Lyman, to the fact that the Club had many times discussed ways and means of making meat cheaper in New York, and at the same time giving the prairie farmer and ranch owner a better profit. The problem, he said, is not without intrinsic difficulties, and he was glad to know that many inventors and business men at the west are working at it, and have brought out methods more or less perfect. The latest was that of Mr. T. L. Rankin of Kansas, who within a week, had brought a car load of Buffalo meat from western Kansas, where it was slaughtered, and sold the same in this city at paying rates. He sent several pounds of it to the Metropolitan hotel, and those who ate of it there found it a delicacy, it being tender, juicy, and having a fine gamey flavor. He hoped Mr. Rankin, who was present, would tell all about that beef, and how he brought it.

Mr. T. L. Rankin.—I do not believe in putting meat on ice. It will of course keep as long as the ice is all around it, but the moment you take that meat off the ice it sours and spoils very fast. A far better way is to keep the air from it and make an atmosphere dry as well as cool. This I do as follows: In the roof of the car is a zinc chamber for ice, the bottom of which slopes at an angle of four inches to a foot. It is made cold by ice above. Then all the moisture in the air of the car is drawn toward that cold zinc, and being condensed, runs down and is carried off. The walls of the car are lined with several layers of the best manilla pasteboard carefully nailed and pasted so as to exclude the air, and the door fits on a thick rubber strip and fastens with a screw that forces it down on the rubber and makes a joint nearly air-tight. When killed, the meat is kept cool till the car is ready to start. I can put from 18,000 to 20,000 in a car, taking care to hang it carefully. Then 200 or 300 weight of ice on the roof will cool the zinc to about thirty-five degrees. This draws the moisture and warmth from the meat and it is carried at just about sixty-two degrees, most of the moisture being removed. I took beef from Junction City, Kansas, last summer, the mercury at 100 degrees and sold it in Chicago as sweet sound meat, the mercury standing at ninety-six degrees the day it arrived, and for twenty-four hours after. The trouble in transportation is the frequency with which it is necessary to change. According to the present system no less than fourteen shiftings and stoppages are required. When by some wiser arrangement, which might easily be made, this delay and vexation, and expense, are obviated, there will be no reason why best hind-quarters of buffalo beef may not be placed in your markets here at from ten to twelve cents a pound.

Thanks to the Farmers' Club.

Mr. F. D. Curtis.—About a year ago we passed a resolution here requesting Congress to repeal the twenty per cent duty on imported stock, when brought to this country for breeding purposes. It gives me pleasure to repot that to-day Mr. Wm. Crozier, of Long Island received five Berkshire pigs, from England, which were the first animals taken from a ship duty free; the duty would have been, under the old tariff import, which expired January 1, $120, in gold. This Club initiated this movement for repeal, which was subsequently acted upon by the New York State Agricultural Society at the last annual meeting, and now we are gratified to see the request of these societies fulfilled by a free permit of breeding stock. Mr. Crozier wished me to thank the Club for its action. I ought to add that General Capron recommended and earnestly sustained the modification of the law.

In Praise of Tide-water, Virginia.

Mr. W. H. Wood, Surrey county, Va.—The lands are gently rolling, requiring but little drainage, no irrigation; with rich veins of shell-marl, by analysis equal to agricultural lime; with plentiful supply of muck beds, and springs and living streams on almost every farm. Soil good and varied, with heavy clay subsoil, making it susceptible and retentive of highest state of improvement; improved lands yielding fine crops of corn, wheat, oats, clover, peanuts and sweet and Irish potatoes; with good pasturage for stock; climate healthy, temperate and salubrious, with long summer, late fall and early spring, giving eleven months for out-door farm work, requiring no special attention to fruit protection. Fruit-growing has been most profitable for years to our own people, and within the last ten years many from the north have engaged in the cultivation with flattering success. Apple, apricot, peach and pear, yield abundant and perfectly developed fruit. The early Tilliston ripen on 4th of July. Strawberry and blackberry generous in yield, latter mostly spontaneous. Wilson Albany seedling ripens on 14th May. These statements are from actual shipments. Other early varieties of peach and strawberry would ripen comparatively as soon. Timber, yellow-heart pine, pine for cordwood and charcoal, white oak, hickory, ash, gum and cypress, in great quantities, with easy shipping facilities convenient. Churches and schools convenient in most neighborhoods; society good, kind and hospitable: post-routes and county roads amply supplied; farms with improvements, of from 100 to 1,000 acres, and timbered lands in any quantity, can be purchased on most reasonable terms; mills with water-power; stands for business, mercantile and mechanical, are offered on most inviting terms. A large accession to the 100 intelligent, industrious and enterprising emigrants already settled here is much desired. Parties inclined to make a tour of inspection will be heartily welcomed.

CURE FOR CRIB-BITE.

Mr. W. H. Gage, Fayetteville, N. Y., would like to know is there any remedy for crib-bite in horses.

Dr. Gregory.—I have known a country gentleman who advised that castor-oil be smeared upon the wood.

Dr. Isaac P. Trimble.—Crib-biting is simply a pressure by the horse with his upper teeth; and I have never seen other successful remedy than by filling the wood with nails.

ASHES IN COMPOST.

Mr. A. D. House, Coventry, Vt.—I have a muck lot, accessible only in winter. Have recently formed a compost heap of one part fresh horse manure, two parts muck and unleached ashes, mixed in proportion of one bushel of ashes to ten of muck. What effect will the ashes have on the manure? Will the compost be fit for use the coming spring?

Dr. F. M. Hexamer.—The compost of muck with horse manure was just right, but the ashes had better be put on separately. There is no gain by composting ashes. They should be spread broadcast on grass, or dropped in the hill with corn and potatoes.

HEDGES FOR PRAIRIES.

Mr. F. Kees, Beatrice, Gage county, Nebraska.—Which evergreens would you recommend for Nebraska, and where can seed or plants be got? I would like to plant some this spring. I planted European larch last spring, but none lived; it is a most important item to have wind-breaks; I shall try it again.

Mr. A. S. Fuller.—When he tries it again let him plant in a cool place, and keep the young plants shaded till they get some growth, and then transplant. The osage orange is the best plant for him. Let him get the seed and plant in the garden and set out when a year old. Some have made an excellent fence by waiting two years and setting out the osage when it is four feet high. That which he sets out for a wind-break must be wider and allowed to grow high. He cannot very well have a tight fence and a high wind-break out of the osage at the same time.

BERRY'S POTATO DIGGER.

Dr. F. M. Hexamer exhibited a drawing of a potato digger. The machine is the invention of a Dr. L. Berry, Clyde, Wayne county, N. Y. It cuts the weeds and grass from the sides of the hill when desired to do so. By a very ingenious apparatus the vines are pulled from the rows, digs the potatoes and separates them from the dirt, leaving them in rows. The machine will dig from three to eight acres per day. I think it a very desirable machine, and hope by the time the potatoes are fit to dig that the inventor will have the machine in the market.

Adjourned.

January 31, 1871.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

SUBMERGING SAW-LOGS.

Mr. Shelby Reed, Scottsville, N. Y.—Theoretically, it is a fact well known that timber submerged in water does not decay. Practically, would it be a paying investment to so preserve it in wooded districts not yet opened up by facilities for transportation, where timber can be had for the removal, and, in some cases, a bonus with it? Nobody believes that a fair use is made of the whole 10,000,000 acres annually slain. Could not a large per cent of that destroyed by the usual methods be profitably held in this way for future use? But the poor settler cannot afford to work and wait for so long a pay day. If done at all, it must be by the capitalist. I hope that the Club will be pleased to favor the public with its opinion upon this subject.

Dr. Isaac P. Trimble.—In the geological report of New Jersey, by Prof. Cook, will be found some interesting particulars relative to the quarrying or unearthing of logs of white cedar in south Jersey. It is quite a business in some counties, especially in Cape May. The sap portion of these logs is decayed, but the heart is always sound, no matter how long buried. Rails and shingles are made from them.

Portions of the dismal swamp in North Carolina, where there is fall enough for drainage, are made into plantations. In digging the canals and ditches the remains of immense trees are constantly found, generally the cypress. These, like the white cedars of New Jersey, are perfectly sound, and are often made into shingles. In the digging of a canal as an outlet for the drainage of several hundred acres I saw an immense cypress cut which showed that it was more than 1,000 years old, and under its roots was found the body of another cypress that the growths proved a similar age, the two together making about 2,000 years. The first of these trees was growing when the Savior was on earth. Portions of the heart of that tree have been fabricated to crucifixes by church members in that neighborhood.

Mr. A. S. Fuller.—It is the custom to immerse ship timber in this way, but whether there would be any advantage in following the practice on a large scale depends on how long a man expects to live. It is questionable if wood will become so scarce as to make it profitable during this generation.

Winter Care of Poultry.

The committee appointed to visit poultry yards, and ascertain the best mode of carrying feathered stock through cold weather, reported progress as follows: On Wednesday last we spent the day at the farm of Warren Leland, twenty-five miles north of this city, at Rye station, and have derived, from a careful survey of his yards, ideas which we consider important. We find him carrying 150 turkeys, about 300 hens, a large drove of ducks, and several dozen of geese through the winter, without the loss of any of his poultry by disease of any sort, and without the freezing of their feet or of their eggs. We learn that he never has maladies among his poultry, that he will allow the greater part of his hens to set in the spring, and each of them will yield an average brood of ten chicks; so that he will raise about 3,000 chickens from his present flock, and his losses be very few. How does he do it?

His hens, ducks, and geese have the best winter quarters we have ever seen provided for any of the feathered tribes. Their main barrack or hennery is a stone house seventy-five feet long, and twenty-five feet wide, and faces south. The openings on the north side are small and filled with window glass, and in some cases with double sash. Those on the south side are much larger, consisting of double doors, which are opened on sunny days. In the middle of the north side is a wide old fashioned fire-place, with crane and a big camp kettle.

Nearly every day in winter a fire is lit and fed with chunks, knots and old logs that would otherwise be knocked about the wood yard and left to rot in fence corners. The walls are of stone and the floor of rock or earth, so the fire can be left without the least danger. On cold days, and especially in cold rains, the hens gather before this fire and warm themselves and trim their feathers. The chimney can easily be closed, or the logs rolled out into the middle of the building, and feathers or sulphur used to make a fumigation. This is done whenever hen lice appear; and the openings of the house can be closed so as to hold the fumigation till it penetrates to every crack; smoke he finds better than carbolic acid, or kerosene, or whitewash to drive vermin. The roosts are oak slats an inch thick by two and a half inches wide, fastened to the rafters near the ridge. They are nailed at different heights and at proper intervals. About two feet below the perches is a scaffold of boards that fit quite closely. This is from time to time covered with plaster and ashes. About once a month the accumulations are shoveled down and piled up for the corn-field. He calculates that fifty hens yield in the course of a year as much compost as would be worth fifty dollars in bone meal; that is to say, if he threw away his hen droppings and had to buy the same amount of fertilizing salts in bone-dust it would cost him fifty dollars to replace fifty hens as producers of manure. He had paid special attention to the comfort of his hens on the perch. They sit on a slat two and a half inches wide; their breast feathers come down and cover their feet and protect them from freezing in the coldest nights. Of course there is no lack of dry ashes in their house, and he finds that after the fire goes out the hens use the hearth as a place to nestle and shake ashes through their feathers. They enjoy it, and it keeps them sound and comfortable. The offal of the farm, as entrails, feathers, heads, scraps from lard, and all the odds and ends from the kitchen are thrown into this house and the hens pick it over, eating all they want. Then, as soon as spring opens, all this trash is shoveled and scraped out, composted and taken to the corn-field. Besides this refuse, his poultry eat about a bushel of corn in winter a day, and half a bushel in summer. He raises large crops of corn because he has strong manure to feed his crops with; his calculation being that about four acres in corn go to feed and fatten his poultry. In spring, after a hen has hatched, her nest is taken out, the straw burned, and the box whitewashed inside and out, then filled with fresh straw and put back for another family party.

After many trials of breeds he has settled upon the white Brahmas. They lay more uniformly the year through, make the best mothers, and the chicks grow the fastest. During summer his poultry have a wide range and scour the fields for half a mile or more, consuming grasshoppers. His turkeys nearly make their weight on grasshoppers and beetles, with a handful of corn night and morning. One man has little to do in spring and summer but to take care of chickens and young turkeys. In winter they require but little attention, and this man then attends to the calves and lambs. The cost of his poultry meat, and he often kills in a season 300 turkeys and 3,000 chickens, he considers to be about 250 bushels of corn, and the wages of his hen-wife for half the time. His gains he cannot give exactly, for the poultry is eaten very freely by a large family, and sent to the Metropolitan when prices are high, or the supply in market defective in quality. He does not keep exact account of his eggs, for as a rule, he says, the best thing to do with an egg is to let a good motherly hen make a chicken of it.

Your committee conclude their report by an expression of opinion, that the common ideas on the subject of poultry raising on a large scale are erroneous. It has been said again and again in this Club, and in farm journals, that there is no use in trying to keep more than about fifty hens; if one goes deeper into the poultry business there is backset from lice, and roup, and gapes, and cholera, and the sudden death of hens and chicks from causes unknown. This is a fallacy. In the manner above described, by the wise use of smoke, and lime, and ashes, and a fire, by cleanliness and a wide range in the milder weather, we find Mr. Leland taking about 4,000 feathered animals through the season, for year after year, without calamity or loss and on an expense that is very trifling and unfelt on a large farm. Your committee will visit other farms where the special object is eggs, and announce the result of their observations.

J. B. LYMAN, *Chairman.*

Dr. J. V. C. Smith.—The chief point in the practice of Mr. Leland seems to be that he keeps his feathered friends as near as possible to the conditions of nature.

COOKING CORN FOR HOGS.

Mr. L. P. Brown, of Newport, Ky., wrote as follows: "For several years I have annually raised and fattened about 500 hogs, feeding them entirely on whole and uncooked corn. At present price of pork, however, this will not pay, and I have concluded to cook their food hereafter. Now, would you advise me to feed whole corn steamed in the ear, or shall I shell the corn, grind it, and feed it as mush (cooked)? I have thought too of crushing the corn and cob together and steaming it, feeding it cold. Would the latter plan be a good one? Is there any nutriment in the cob when well cooked, and would any evil probably result from feeding it to hogs?

Mr. D. B. Bruen advised him to shell his corn and use the cobs for fuel to cook the same.

Dr. J. V. C. Smith thought it strange that people at this late day will talk of cooking food for pigs. Cooking accounts for the measly and unwholesome condition of their flesh.

Mr. D. B. Bruen believed the judgment of most experienced farmers is in favor of cooking, and the advantage is fully forty per cent. Mr. Leland, he said, ought to cook the corn for his poultry.

Mr. F. B. Curtis said he was in favor of cooking food for animals.

Finally, it was voted that Mr. F. D. Curtis and Dr. J. V. C. Smith be requested to embody their views in brief essays, to be presented at an early day.

MARKETING, DAIRY AND OTHER PRODUCTS.

Mr. David W. Lewis, New York city, read the following paper: Before there were railroads or canals; when Black river country was a wilderness, and Utica was the far west, and pioneers used to boat their goods on the Mohawk; when the business of the entire State was less than is done in Oneida county, and the machinery of transportation and exchange was difficult and laborious; when toiling teams and swearing teamsters tugged and lugged at the produce of the country like ants on a sand-hill, and it was odd-and-even whether the expense of horses and drivers wouldn't eat up the produce carting it; when butter was worth eight to ten cents, cheese four to six cents; when the load of grain couldn't be sold for money, and would only barter for about a spelling-book, a jug of molasses, a little old-fashioned corn-whiskey, and a calico frock; when here and there a few resolute dairymen from the Chenango valley would sometimes drive their own teams in midwinter through to Catskill, across the Hudson, on the ice, and down to this city, selling their own dairies, from their own cutters, at twelve to sixteen cents per pound, and beating their neighbors, who sold at home, then, in the light of these former days, the good old times we sometimes sigh for, let us look at the present advantages the country has for the sale and transportation and exchange of its products. Next to the old turnpike days came canal transportation, an improvement, but by its closing in the fall compelling the sale of the bulk of the crops within the limits of a restricted market, and to buyers who found it necessary to take on the property cheap enough to allow for its carrying, storing, and the fluctuations of the winter markets.

Telegraphs are the nerves of the country; railroads and canals the arteries and veins through which flow the nutrition and waste of the whole body politic. Cities and towns are the nerve centers and vast stomach of the world, down whose capacious maws disappear its products, and from which digested matter is flung back through the village and hamlet and open country, and into all the extremities of the land the tingling sensation of life and the impulses for motion and advancement. To contribute to this evolution of matter, and the elimination from it of the higher forms of life and beauty, and the world's progress and enjoyment, it is the duty and pleasure, not only of the farmer and producer, but of the carrier and factor, and the humblest farm hand or grocer's boy who assists in the work. The dairy interest of the State of New York is its great agricultural interest; its growth and development in the past twenty years, its perfection of manufacture and system of marketing, is a matter for congratulation, an incentive toward further improvement, and shows to all branches of agriculture what may be accomplished by thorough system and good management. The factory system of cheese manufacturers, and the fact that they are making the central localities in their cheese districts the distributing points of the product, and that a large portion of the make is sold almost directly from the shelves to exporters, shows what can be done where science and system take the place of guesswork and uncertainty. In butter the same processes are going forward, and factories or creameries are turning out a make as uniform in quality as honey in a hive. When the brands of these creameries and factories shall get to represent an exact standard, and the leading private dairies shall adopt the creamery system and turn out butter as nearly an even quality as a brand of flour, then retailers and consumers, and all unskilled buyers, may get along without the skilled judgment of dealers in selecting their stock, and the product may be sold from the creamery and dairy-room, and distributed direct from the central points within the dairy districts, thus bringing the producer and consumer in easy communication. To this end, in addition to the best exertions of the farmer and his agents, how necessary is the freest possible communication through all parts of the State.

This is being rapidly accomplished by the pushing of railroads over the national highways of travel; and if the full benefit of competitive rates for freight and passage are allowed to work freely, there would seem to be not much more to ask for, except that we be not too much governed, and that legislation should confine itself to its legitimate sphere, without attempting to farm out the franchises and labor of the country, and to place restrictive laws upon the free transportation, sale and exchange of the products of our hands and lands everywhere.

CHARMS OF THE PACIFIC SLOPE.

The Rev. J. M. Driver, who has for nineteen years ranged the great regions on the Pacific shore from Puget Sound to Los Angelos, was introduced, and indorsed the opinions before expressed by the excursion party. Much that he urged related to the commerce and railroads of Oregon. As to its agriculture, he said: Our wheat crops are unequaled, because the air is cool and dry while the plant is maturing, and the straw is so clean that a man can bind all day without soiling a white shirt; rust is unknown. Our farmers are probably the least industrious and systematic of cultivators, yet few can show better returns for the little we do. As to the costs of freights, I will say that I can bring a ton of wheat from Puget Sound, as cheap as you can roll it from the Genesee Valley to this city. There is not in the whole range of industry a business so sound and sure and honorable as to take a tract not too far from a harbor, and go largely into the wheat business. The soil of that country is singularly strong and lasting. It contains great quantities of potash and soda, on which a score of wheat crops can feed and make themselves without fear of wearing out. In our harvest time, we have a wonderful advantage. We are absolutely free of rains at the time when rains would be a nuisance. With the exception of a few tule islands and coasts which are not inhabited, our climate and soil are absolutely free of all causes of disease. It is the healthiest country in the world; it is a climate where a working man can be comfortable at his labor for 300 days of a year. All the drawback we have is the population. In that respect we are going through a series of changes. First, we have the *moccasin*-men, who kill bear and dear, and fight indians, and live in tents and huts. They move on to wilder ranges, and give place to the *shoe*-men; these make fences, sow grain, keep cattle and sheep, but are content with a little, live far apart, and their roads are bridle-paths; after them come the *boot*-men. They are mighty, and at their step the face of the country changes, and the wildness of nature is banished. They cut forests and load them on great ships; they import strong engines from Birmingham and Glasgow; they bridge great rivers and tunnel granite sierras. Palaces of hammered stone rise up at their bidding; religion has her temples and art her headstones of beauty. Now what we ask of you is a strong deputation of your boot-wearing population. Send us families that love schools and newspapers, and chapels and lectures. We can find for such people, homes as beautiful as poet ever sang of, fertile glens and valleys, where the branches of the apple and the fig-tree can interlock, and oranges hang their golden rind above great purple clusters of delicious grapes. I may seem to use the language of romance in speaking thus of the charms of that beautiful land, but to be plain and statistical, I will say that in most places from $3 to $10 per acre will buy land moistened by Pacific fogs, which will yield forty bushels of wheat, sixty of corn, and from one to two tons of grapes year after year without manure, in a climate where you seldom need an overcoat in January, and often kindle a fire in July. I advise families to come in clusters. To such our ships will give special rates in travel, and in buying land a moderate cash payment will place the settler in possession of all the land any man needs.

Though our people on the slope are not as pious as I wish they were, they will be most happy to see coming into their land such people as I see and reach through this Club; men who read the Bible, and women who sing the songs of Zion. God has fitted up a chosen region there for those who will fear Him and keep His commandments.

I hope you will come and see the land and buy of it, and labor on it, and create for us those prosperous, temperate, and righteous communities that are the glory of your older and riper civilization.

SUGAR FROM SOFT MAPLE SAP.

J. Waggoner, Burlington, Mich.—That recently at the house of a friend he was eating some excellent sugar made from soft maple, and that the following reply was returned when he expressed surprise: "The sap of the soft maple is not as rich as that of the hard maple, taking from one-fourth to one-third more to make the same amount of sugar. But the former flows more freely than the latter, so that the yield of sugar is nearly equal to that from an equal number of trees. This involves more labor in gathering and boiling; but, again, the soft maple commences its run earlier, so that sugar-making from it is out of the way of all preparation for spring work on the farm, and gives the advantage of an early market, which is an important item, as all sugar-makers are aware. The gentleman from whom I gathered these items, after a number of years' experience, said he would not exchange his grove of soft maple for one of hard maple."

Adjourned.

February 7, 1871.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

ROOTS FOR MILCH COWS.

Mr. H. L. Wadsworth, Litchfield, Minn.—Which is the more valuable food for cows when butter is the object? Carrots, turnips, or mangel-wurzel beets?

Mr. S. M. Wells.—This is a subject on which I once felt some doubt, but ten years' experience has settled my mind perfectly. There is but very little difference between these roots in their effect upon the appetite of a cow. These roots, be it remembered, are of little worth in themselves, but they help a cow to digest and assimilate, and turn into milk dry and coarse food that otherwise would be half utilized and half wasted. I have come to the conclusion that the best root is that which can be put into my cellar at the least cost; by that rule turnips and carrots will give way to the mangel or big beet. I don't believe Mr. Wadsworth or Mr. Gibson, or any other smart farmer can put a bushel of carrots into his cellar for less than ten cents. My beets sometimes cost me ten cents, but often not over five cents. They can be kept clean with the hoe; they grow livelier and get bigger; they pull easier, and fill up faster than any root that I have tried.

WASHINGTON TERRITORY.

Mr. E. Meeker, of Olympia, W. T., showed a large collection of preserved flowers, brought from his section, and spoke of them and of his far-away home as follows: I have lived seventeen years in the vicinity of Puget sound, and hence what I say is based upon actual experience and observation. The waters of Puget sound extends across two degrees of latitude, forming numerous bays and inlets, safe in all its parts for the largest class of vessels, and so ramified that there are 1,833 miles of shore line embraced within its limits. These waters flow into a capacious basin of say fifty miles in breadth, bounded on the east by the Cascade mountains, and in part on the west, by the Olympian or coast mountains, the higher points of which are covered by perpetual snow. The general surface of this basin is covered by magnificent forests of timber, the better specimens of the yellow fir, often over 300 feet in height, and from which we manufactured and exported during the year 180,000,000 feet of lumber. Ten mountain rivers cross this basin and pour their waters into the sound, upon which are found rich alluvial deposits, in valleys of from two to four miles in breadth, and cut down below the general surface from one to four hundred feet. Upon these bottoms there is usually a growth of deciduous timber, that form a striking contrast to the evergreen timber found on the table-lands. All through this region there are small prairies and openings, as an exception to the general character, many of which are rich and fertile, and upon which an industrious hand can make a quiet yet prosperous home. The crowning wonder of that region is its climate. Although in the latitude of 47°, I was able to make a selection of fifty-three varieties of flowers from the open gardens and common, on Dec. 4, the day prior to my departure from Olympia, and which I have preserved and have here for inspection to-day. These flowers are not exhibited as particularly rich or rare, although there are some specimens which I believe are peculiar to that region, and which I will not undertake to name. You will notice several varieties of the rose, the honeysuckle, woodbine, marigold, wall-flower, pinks, dahlias, etc.; yet I will not occupy your time by reading over the whole list. Mr. H. R. Woodward, of Olympia, wrote me Dec. 3, that he would send "some clover stalks in bloom; having grown late in the season, their length is but little over four feet. Our last green corn we picked yesterday. My round turnips are now good for use. The seed was sown Sept. 15. Ruta-bagas are still growing finely." I have myself grown the white turnip seven inches in diameter from seed sown in September. At the Thanksgiving dinner, Nov. 25, 1870, at Seattle, there were ripe strawberries and green peas upon the table, raised in the open garden, and over twenty varieties of flowers graced the table, all of which grew in the open air. On the 10th of January, 1870, Mr. Woodward exhibited twenty-two varieties of flowers growing in that State in the open air near Olympia. This week I received a letter from A. A. Manning of Olympia, and bearing date of January 10, 1871, in which he says: "I saw in Hartz's garden a fine, beautiful rosebud just ready to bloom; think of us and shiver." You see, my friends, that the flowers exhibited to-day are not the result of an exceptional case, but fairly exhibit the mildness of our climate. I think we have had less than four weeks of freezing weather for an average of the last seventeen winters, and five inches of snow, which usually remain but a few days. Meteorological observations taken at Fort Steilacoom in lat. 47° 7′, for a series of years, give the following result: spring, 48° 27′; summer, 63° 3′; autumn, 57° 25′; winter, 40° 42′. Mean annual precipitation of rain and melted snow for six years, location, Steilacoom; latitude, 47° 7′; altitude, 300 feet; spring, 11.19 inches; summer, 3.85; autumn, 15.83; winter, 22.62. We have no great extremes of either heat or cold. Our summer evenings are always cool and refreshing. The resources of that region are varied, and will eventually build up a prosperous community. It has been denominated the "New England of the Pacific," which is only in part applicable. We have all or nearly all of like resources as are found in New England, yet escape its rigid climate. Our wheat is of most excellant quality, yields a large return, and weighs very heavy to the measured bushel. In fact, the same may be said of all the cereals except corn. Of that we raise only a limited quantity, in consequence of our cool nights. Vegetables of all kinds yield large returns, and the quality far excels anything I have seen east of the Rocky mountains. We do not raise the grape or the peach to perfection. The apple, for size, color and flavor, cannot be beat in any country, yet the tree is not healthy. The pear tree is healthy and the fruit good, and both come into bearing very early, often times the second year from the graft. All the different kinds of small fruit flourish well, produce abundantly, and are of most excellent quality. I saw "Oregon apples" at Omaha and westward from that city along the line of the railroad across the continent. We have a climate in which grass will grow during the greater portion of the year. The water is pure and soft, generally distributed, and well suited for dairy purposes, and already "Puget sound butter" is a favorite in the markets. We have timber in unheard-of quantities and of most excellent quality. I was on board of a thousand ton ship just ready to launch at Port Madison, every stick of which was "Puget sound timber." We shall build and equip ships as well as export timber. The cod fisheries of the northwest coast are known to be extensive, and the curing-ground will be upon Puget sound. The whaling interest will also concentrate at this point the day that we have direct communication by rail across the continent. Here is a specimen of iron ore recently discovered by Hon. A. A. Denny, of Seattle, our former delegate in Congress, and Prof. Hall, of our territorial university. This mountain of ours is situated about forty miles east of the sound, near the Snoqualmie Pass, and within two miles of the line of the Northern Pacific railroad. We have limestone upon San Juan and Orcus Islands, with stone-coal underlying the whole region. The iron ore is found in inexhaustible quantities, within easy reach of water-power and other facilities favorable to the development of the iron interest. An army of 3,500 men are now patiently at work upon the Northern Pacific railroad, reaching from Lake Superior to Puget sound, the whole to be completed within five years, and forming a continuous line, under the control of one company, for nearly 2,000 miles. Already sixty miles of iron is laid, 150 more of the road-bed graded, with the assurance that the road will be completed to the Red river of the north by the first of July, 1871, a distance of 243 miles. On the western end, and near Puget sound, 500 men are at work, and the first section of the road will be completed by the first of July, 1871. Hence we know that the company are alive to their interest and to that of the public, and that we are to have a new railroad spanning the continent, having its western terminus upon the shores of Puget sound. Land is cheap in that country, so easily obtained that any one can get a home by going there. Upon even-numbered sections along the line of the railroad, heads of families can enter land by virtue of the preëmption or homestead laws, and for the balance, or odd sections, accruing to the railroad company as the road is completed, we have the assurance that it will be sold to actual settlers upon long credit and easy terms. To get there, one must go first to San Francisco, thence by sail to the sound. The present cost from New York, either by steamship line or by railroad, is sixty dollars, currency. Should he go by rail, the emigrant can take his provisions for the trip with him. The time will be twelve days to San Francisco. From thence there are thirteen independent lines of sailing vessels running to the sound; consequently there will be not any delay in obtaining passage. The fare for the emigrant to the sound is twenty dollars, coin, and the time occupies about fifteen days. It is safe to say that $100, currency, will land a person from New York city to Puget sound, if economy is used; and yet the trip may be made comfortable and pleasant.

Dr. Smith.—I think we ought to value these statements very highly, for the reason that they are about a remarkable section of country concerning which we know too little, and concerning which facts have not hitherto been very numerous.

Kansas.

George N. Nichols, Delphos, Kansas, forwarded the subjoined statements in reference to the Valley of the Solomon: This stream takes its rise in the north-western part of Kansas, and has a general southeast course, emptying into the Smoky Hill about forty miles above, where the latter unites with the Republican, and forms the Kansas river. This valley is chiefly remarkable for the broad river-bottoms, great fertility of its soil, beautiful scenery, and its entire freedom from all swamps, marshes, lagoons, etc., thus giving assurance of a healthy climate. Until within the last summer, this valley has been but sparsely settled, owing to incursions of hostile Indians; but now all fear on that score is entirely removed, and during the past summer and autumn following, emigration has been pouring in at an enormous rate. And yet there is room. Thousands of acres of government land, open under the homestead and preëmption laws, as beautifully situated as any that I ever saw in central or western New York, with a superior climate, lie up and down this valley. Young towns are springing up all along, mail routes and post-offices are already established. Fine claims can now be had within a short distance of what will soon be large and thrifty villages. As a stock-growing section, I cannot see how it can be easily surpassed. It is finely watered by numerous streams putting into the Solomon, and the range back in the bluffs will afford fresh and unlimited pasturage for many years to come. The winters are short and mild, so much so that some stock-growers do not feed a pound of hay. It is usual, however, to secure about a ton per head. I know it is a common remark for this one, or that one, to say that they have the finest stock country in the world. Mr. Meeker thinks between the Cache la Poudre and Thompson rivers is the best. Another in Montana is sure he has found the favored spot. I am satisfied, from careful observation, that one acre in this part of Kansas will afford more pasturage than two acres between the above named rivers, and equally as rich, as the grasses are very nearly similar, while our winters cannot be as severe, as the above locality is at much greater altitude and further north. It is folly to talk about short, mild winters, where they have frosts in June and snow storms in August, as they did in Colorado last summer. Mr. Meeker omits to mention the cactus that grows so thickly there, that for miles square a cow will hardly undertake to lie down, except perhaps to die. The latter, I should say, they not unfrequently do, judging from the number of carcases scattered over the plains in the spring time. I presume the mild winters prove a little too much for them. I would advise no one to sell out and go west on the representation of another. We don't all see things alike. Go and examine for yourself. If you find a place that suits you, put up a cabin, and send for the wife and little ones; get a few cows; then, with judicious management, your future will not disappoint you. Five hundred dollars invested in stock now, will, with proper care, in ten years make a rich man of you. There is no danger of these vast prairies being overstocked. Cattle can be raised so cheaply here that the time is fast approaching when eastern cities will obtain their supplies of beef far beyond the Mississippi.

Adjourned.

February 14, 1871.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Hotbeds.

Mr. J. C. Dolbow, Pennsgrove, N. J.—I wish to give the Club my way of making hotbeds for sweet potatoes; how we manure, set out, and tend. To make the hotbed, select a high, dry piece of ground, ditch out five feet wide, twelve or fifteen inches deep, fill half full with old hay, put one two-horse load of manure to twenty feet. It need not be more than half horse if it is composted one week before using it. Cover it two and a half inches deep with loose sand, lay the potatoes one basket to the pace or three feet, cover two and one-half inches deep with sand, cover the bed with old hay five or six feet deep, and watch and not let it get too hot or it will burn or scald the potatoes. In five or six weeks the plants will be ready to set out in the hill. Keep the bed covered till the plants are up, then uncover to the sun, covering at night. We prepare the ground, plow, shovel, harrow both ways, make two and one-half feet square, put a small pan shovel full of manure in the hill, which should be composted a month or six weeks before use; make the hills sharp; set out the plants and tend for one week with hoe and harrow, and repeat two or three times

Moths About Bee-hives.

Mr. J. H. Martin, Hartford, N. Y.—I am a bee-keeper, and have always found the so called moth-traps the greatest curse a bee-keeper can introduce to his apiary. Moths certainly do congregate in them, and a very little neglect makes the congregation too large for ordinary apiaries to survive. It is impossible to keep moth-worms from the hive. The moth will lay its eggs upon the alighting board, and upon the blossoms daily visited by the bees. The eggs stick to the bee and are carried into the very center of the hive. The only safe, and the very best moth-trap, is to keep the swarm strong. The weak swarm, or one without a queen, is the one that falls an easy prey to the moth. The movable-comb hive is admirably adapted to keep a swarm strong. Wood and glass, and almost every other substance have been tortured into hundreds of patent hives. But any farmer with a little ingenuity can make a good plain, movable comb hive.

Fresh Eggs in Frosty Weather.

Mr. E. S. Humo, Laytons, N. J.—Warren Leland's management of his Macduffs is excellent, but I'll give you my plan. I would say, to begin with, that my variety (a mixture of Cochin-China) are not supposed to be the best for laying. They are very large too, some of the hens weighing eight pounds; but then I flatter myself, with my system, almost any kind will lay. You would scarcely believe me were I to tell you how many eggs we get through the coldest weather. Suffice it to say that they will compare favorably with the marvelous stories I have seen in your columns. And now for the secret. Bones, bones is the word. Give them bones with meat or without meat. Cut up or break the bones as soon as the family has done with them, and instead of throwing them to the dogs, or in the soap-fat keg, give them to your hens, and with the proceeds of the increased number of eggs you can buy at the store a better article of soap than you make, and then you have the ashes for your apple trees and grape vines. In addition to bones (but they are paramount), on cold mornings we give them hot mashes with a small quantity of Cayenne pepper stirred through it. Give all the fresh water they want, also plenty of dry dirt to wallow in. Keep them well secured from the cold; have window lights on the sunny side; and, my word for it, you will be rewarded for your trouble.

Clearing out Quack Grass.

Mr. C. Becker, Bloomville, N. Y.—I have succeeded in destroying quack grass by cultivating thoroughly with a hoed crop; then plow well in the fall, and, as soon as the ground becomes dry in the spring, put on a good cultivator, work up the roots and expose them to the frost at night and sun by day; then put on a harrow with the teeth pointing a little forward; when the drag gets full raise it up and drop the roots in rows so as to gather them up and put into the compost heap, and, by thoroughly working the land every other day for six to ten days, the roots will be mostly extracted and the land brought under good cultivation.

NORFOLK AND PETERSBURG COUNTIES, VA., FOR VEGETABLES.

Mr. M. Marshall, Petersburg, Va.—I claim there is no section of our country where a man of moderate means can do better than in this part of Virginia. It is true that our lands are not as good as some of the western lands, but I will tell you what any good farmer can do. In the first place I will mention the fact that a barrel of potatoes, apples, or any other farm produce, can be shipped direct from this place to New York city, by first-class steamers, for fifty cents, and there is no place on earth where early vegetables can be raised better than in this section of Virginia; 250 bushels of sweet potatoes can be raised to the acre. Our average yield of cotton is 225 pounds to the acre, and tobacco 600 pounds, while we can raise at least fifty bushels of peanuts, worth $175 per acre. And, while speaking of the average, it is well to bear in mind that we have thousands of farmers and freedmen who have nothing in the world but a hoe to raise their crop with, under which circumstances it is natural that they raise very poor crops, which reduces the average of the good farmer. I have mentioned the above crops because they are our leading crops; but there is nothing that grows in any part of the United States that will not grow as well here.

RENOVATING THE BANKS OF THE POTOMAC.

Mr. Edward Daniels, Iona, Fairfax county, Va.—Within twenty miles of the capital of the nation are the banks of one of the noblest rivers of this continent, and we find it will pay to renovate these worn lands, and keep up the richness of those that are fresh. Oyster-shell lime, which costs us ten cents per bushel; marl, costing us about one dollar per ton, laid down on our beach, are the best agents for this work. Muck, and the vast vegetable accumulations on the beach and in the forests, come next, bringing in great crops of clover and timothy, orchard and blue grass, to be fed to milch cows, and the manure returned to the grass lands to grow more hay. This process builds up the land, and pays as it goes along. Our lands require lime, and, where they have been exhausted, fibrous matter of some kind worked into the soil. On our new lands lime works wonders also, and gives enormous crops of corn, sweet potatoes, white potatoes, rye, and oats. Wheat ought not to be grown here yet, though naturally it is one of the best crops for Virginia, but it can only be put in a rotation where the land is much improved. Acknowledging our many obligations to the Farmers' Club, we trust it will continue its great career of increasing usefulness and influence till the whole country is magnetized by its enthusiasm and enlightened by its intelligence. To its numerous inquirers for rural homes we extend a cordial invitation to come and see us, and we will extend the hospitality of our homes and hearts to true men and women who come among us to help in the divine work of making the earth a paradise of beauty and fruitfulness.

KEEPING FRUIT.

The following rules for keeping fruits are from the proceedings of the Royal Horticultural Society:

1. As the flavor of fruit is so easily affected by heterogeneous odors, it is highly desirable that the apple and pear rooms should be distinct.
2. The walls and the floors should be annually washed with a solution of quicklime.
3. The room should be perfectly dry, kept at as uniform a temperature as practicable, and be well ventilated, but there should not be a thorough draught.
4. The utmost care should be taken in gathering the fruit, which should be handled as little as possible.
5. For present use, the fruit should be well ripened; but if for long keeping, it is better, especially with pears, that it should not arrive at complete maturity. This point, however, requires considerable judgment.
6. No imperfect fruit should be stored with that which is sound, and every more or less decayed specimen should be immediately removed.
7. If placed on shelves, the fruit should not lie more than two deep, and no straw should be used.
8. Where especially clear and beautiful specimens are wanted, they may be packed carefully in *dry* bran, or in layers of *perfectly dry* cotton wool, either in closed boxes or in large garden pots. Scentless sawdust will answer the same purpose, but pine sawdust is apt to communicate an unpleasant taste.
9. With care, early apples may be kept till Christmas, while many kinds may be preserved in perfection to the second year.

Adjourned.

February 21, 1871.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Success in Farming — The Worth Homestead.

Dr. Isaac P. Trimble submitted the following report: A very large number of the letters received by this Club are from persons anxious to know where to emigrate to, with the best chances of success in farming. We have also many letters extolling the advantages of almost every part of our whole country. Lately we have had representatives from Colorado, California, Oregon, and last week we had the pleasure of listening to an interesting account of the soil, climate, and resources of the country about Puget's sound, in Washington Territory. The high coloring of some of these accounts will have the tendency of making many a farmer's son dissatisfied with home, and some will probably make grave mistakes by looking further. The committee appointed some time ago to visit farmers among what are called the Brandywine hills in Pennsylvania have lately been furnished with facts that enable them to report; and they now propose to give the history of a single farm during the lifetime of its present owners, showing what can be done by resolutely sticking to the homestead of the fathers. It is the well-known "Worth Farm," on the Brandywine, near the battle-fields of revolutionary fame. The farm originally contained 320 acres, but much encumbered with a debt due other heirs. This land, like nearly all the rest in that region, at that day, had been worn down by the old style of agriculture. The fields grown up with sedge-grass. Hedge-rows of briers and bushes a rod wide on both sides of forlorn fences. The crops of corn were then ten, fifteen, and sometimes twenty bushels per acre; wheat, from five to ten bushels. The hay of the farm was all produced by irrigation, the rivulets being led by ditches so as to overflow a few acres. The entire stock at that time consisted of about ten head of cattle, four or five cows, the rest calves or young animals. Now mark the contrast: This year, 1870, the stock on this farm has been sixty head of beef cattle, eight horses, six oxen, and six cows, making eighty in all. The average crop of corn for the last ten years has been seventy-five shelled bushels to the acre; wheat, twenty-five bushels; oats, fifty bushels; and the hay crop, two and a half tons to the acre. The wheat crop the last season has been much under an average, owing to the excessive heat and rains of the early summer; but the corn crop, on the contrary, has far overrun that average. I have here the certificate of the surveyor, giving the measurement of a field of thirteen acres and sixty-one perches, and also the measurement of the cribs in which the crop is stored, making the extraordinary amount of rather more than 110 shelled bushels to each acre. Here are some of the larger ears, and others of an average size, one from Kansas. It becomes a question of great interest to know how such a mighty change in the productiveness of the same acres could be brought about in the lifetime of one man. There are no marl-pits in Pennsylvania, neither had they any alluvial meadows to draw from for the benefit of the uplands. But the use of lime as a fertilizer was then becoming known in that neighborhood. It was tried sparingly at first. Soon its value was proved, and it has been used at short intervals since, until between 200 and 300 bushels have been applied to every acre. Most of the land now seems saturated, and it is not so often used; still, when a field shows any signs of failing, lime is applied.

Lime-stone is quarried in the neighborhood, and probably underlies this farm. Plaster (sulphate of lime) has also been used. At first it was drawn in wagons sixty miles, proving how much it was valued. Ditch banks and other rich deposits were drawn into the barn-yard for composting. Soon clover grew freely under this system, and where clover grows it is the farmer's fault if his lands are not rapidly improved. These were the fertilizers that gave the start. Soon the fields produced crops of the natural grasses; white clover and the green and blue grasses. Where these grasses grow, grazing becomes the most profitable use of land, and for sixty years the feeding of beef cattle has been the primary object on the Worth farm. The beef, like the butter, produced on the Brandywine region, has long been highly prized in the Philadelphia market, and commanding the very highest prices. This system of grazing has not only been profitable as a business, but the best possible system for the land; taking off less than other crops. Hay or straw are never sold, and even the grain is chiefly fed upon the farm. The original farm buildings were mere sheds. In 1809, when the lime began to tell its story, a barn, forty feet by seventy, was built. It was in the Pennsylvania style; a double decker. The neighbors who assisted at the raising, all said it would never be filled; but in ten years more room was required, and a hay-house, twenty-four by fifty feet, was added, and this also was soon filled; now there are great stacks besides. The Worth farm has not only grown in productiveness, but has increased in size in the same proportion. In 1817, thirty-five acres were added, costing $100 per acre, making $3,500; in 1825, ninety-three, at fifty dollars, $4,650;

in 1838, ninety-three, at eighty dollars, $7,540; in 1852, ninety-three, at ninety-eight dollars, $9,114; in 1867, 240, at $135, $32,500; making a total of $57,304. The farm now being nearly 900 acres, divided into four parts, and managed under the supervision of the owners, by the four young men of the family. The number of acres under cultivation in 1870 has been about 150; 132 have been mowed; about fifty in timber; leaving about 500 in grass for grazing. The stock of 1870 was sixty head beef cattle, 106 head cows, sixteen head oxen, eighteen head young cattle, twenty-two head horses, fifty head sheep, and 116 large and forty-five small hogs, making a total of 433 animals; poultry in vast numbers not included. The farm buildings on the different divisions of this property are like those of all other well-to-do farmers in this part of Pennsylvania. The dwellings of stone, two stories high, and four or five rooms on a floor. We were in these houses, even the kitchen of one of them; it was large, light, and neat as wax; there was the range, the hot and cold water-pipes, in fact, all the modern conveniences. We counted five great barns, all double-deckers. The fences were all of chestnut rails. These are cut from fifty acres on the "barrens," a few miles off. The chestnut on such lands is of rapid growth, and bears cutting off clean every fifteen or twenty years. Hedges of Osage orange were coming into use. The question was asked: "Have you trouble in getting all the labor you want?" "Not any," was the reply. Wages were about twenty dollars a month or $240 a year, including board. The married men had houses, gardens, cow pastures, fire-wood, and other privileges; that is, a laborer who is faithful, is as well paid, and made as comfortable as he can expect to be as a laborer, and he seldom changes. We saw no Irishmen on these farms. Young men of fortune often go there to learn agriculture practically, and they work, and thus get knowledge worth having. Of course labor is economized as much as possible by machinery. The cutting and securing of two hundred or three hundred tons of hay in the old way would cost immense labor, but with the mower, tedder, horse rake and fork, it is comparatively easy, and fickle weather is not now a cause of so much anxiety. Since railroads bring cattle from the far west, making beef has not been so profitable in the eastern States. Formerly cattle kept nine or ten months were expected to bring at least double what they cost. Last year a steer weighing 1,100 pounds cost at six and one-half cents per pound, $71.50. Such a steer is expected to increase 400 pounds, or to 1,500, and when sold at eight and one-half cents, making fifty-six dollars profit per head; and as these cattle usually receive about ten bushels of corn meal each in the latter part of the winter, the profit is much less than making butter or selling milk. Butter-making, however, involves so much care and labor upon the female portion of the family that it has not been adopted on this farm. A year ago one of the young men resolved to try cheese-making. A factory was built, three of the four divisions of the farm were stocked with ninety-six cows. Neighbors contributed the milk of seventy or eighty more. I have here a specimen of the cheese, and some statistics of the business. This statement, however, is only the account of thirty-five cows kept on one of the divisions of the farm. Profits of thirty-five cows from the first of third month, 1870, to first of first month, 1871, thirty-five calves, $212; commenced making cheese April 17 and ended November 18; milk in that time, 158,785 pounds, making 16,413 pounds cheese, or $2,487.44; milk sold from November 18 till January 1, 1871, 3,471 quarts, at seven cents, $242.97; the pigs fed upon the whey will make a clear profit of $600. This makes a profit of just about $100 per cow, charging each cow as he did all others with the expense of manufacture two cents per pound. This shows a much larger profit in making cheese than beef. When last there they were putting up a cheese factory, large enough to make up the milk from 500 cows, and had already 300 engaged for the coming year. At one time some attention was paid to the breeding of superior stock, cattle and sheep; but this is now abandoned as a business. We saw a few thorough-bred Alderneys amongst the herds of cows. Some people will only buy very yellow cheese or butter, and annatto is used to color with. This cheese is colored with Alderney. The soil, or vegetable mold of the Brandywine region, like nearly all the soils east of the Alleghany mountains, is about three or four inches in depth; and as the whole of the Worth farm is upland and much of it quite hilly, the question of the proper depth to plow has been a subject of careful investigation. The elder brother told us that they had discovered early in their experience that deed plowing was injurious, and it had been given up. Now they plow about four or five inches. In breaking up the sod they usually plow round an entire field. In some places they are compelled to go up steep hills, and some of these are also stony. Plowing a stiff sod under such circumstances is almost impossible, and it is often mere scratching. These portions, however, are thoroughly harrowed and planted with the rest of the field; these spots are usually found to produce the best corn. These accidental lessons have taught them to experiment further, and they have gradually diminished the depth of the furrow until, judging by the somewhat convincing argument of 110 shelled bushels to the acre, they have got just about right.

The rotation of crops on the Worth farm is corn, oats, wheat and clover, but the latter is soon crowded out by the natural grasses, which not only take but hold possession. We saw fields of green grass that have not been plowed for thirty years. Such a sod is a mass of grass roots, and being turned under but a few inches decays in time to fertilize the growing corn ; and as the chief part of the feeding roots of that crop are near the surface, corn planted upon such a sod so plowed finds the right food in the right place, and 110 shelled bushels to the acre says so. A little incident during our visit, as illustrating one cause of success, is worth relating. We visited the cow-yard during milking time. It was Sunday evening. The dress of farmers best suited for work is not such as they wear to meeting. The young heir of one portion of this princely estate had donned a loose-fitting suit of coarse material over his first day clothes, and was one of a party of five milking thirty cows. Here was an explanation of prosperity without a word said. "Come, boys," and 900 acres, and such acres, have come in obedience to that call.

NOTED AMERICAN TREES, PAST AND PRESENT.

Mr. Thomas Cavanagh read the follwing paper: An interesting volume might be written upon this subject, full of romance and stirring incidents, connected with the early days of the colonies. Many of the old landmarks have passed away; time, or the axe of the modern improver, has laid them low, and in a few years the remaining ones will have departed and be soon forgotten, or only thought of in traditions of the past. Europe boasts of her lordly trees, and the skill of her scientific horticulturists is taxed to the utmost to invigorate and prevent from decaying some noted and historical tree. The oldest tree in Europe is the Cypress of Somna, in Lombardy. It flourished in the reign of Julius Cæsar, and is, therefore, nearly two thousand years old. It is 106 feet in height, and twenty feet in circumference. Napoleon, who had no great respect for sacred things, in his march through Italy, altered the plan of his road over the Simplon, to avoid injuring this tree; this, in our estimation, atones for many of his acts of vandalism. A few years ago we could boast of a still more ancient tree, the Wellingtonia Gigantica ; or, as it should more properly be called, the Washingtonia Gigantica, the famous big tree of Calaveras county, California. This mighty monster of the forest has passed away. The Indians had, for ages, been in the habit of assembling under this tree upon their return from the chase or foray, and while relating their exploits, the squaws were cooking their food at its base. In course of time it became so much decayed that it was cut down, in 1850. It measured, in length, 300 feet, a portion of its top having been blown off some years previous. It measured, in circumference, over ninety feet. One section of it was hollowed out and sent to the London exhibition. In this section a party of six sat down and partook of a repast. The bark of this monster tree was eighteen inches in thickness. Among the trees now standing in the valley, may be mentioned the Sentinels, 300 feet high and sixty-nine feet in circumference, and the Pioneer's Cabin, 318 feet high and seventy-three feet in circumference. In contrast to this noble tree is the Stunted Pine, called by travelers the One Thousand Mile Tree, from the fact of its being the only tree between Omaha and Salt Lake City. On this account it is celebrated.

At Roxbury, Mass., an Elm tree 150 years old was cut down a few months ago, it having become so decayed as to be considered unsafe. All means should have been used to preserve this tree, for on one of its limbs the lamented Warren hung his scythe when he left his swarth to lay down his life for his country. The past year an Elm tree was cut down in Vermont, with a trunk measuring seven feet in diameter, two feet from the ground. It was 300 years old, and made thirty-six cords of wood. The historic old Elm of Boston still stands, the pride of the Hub. The storm of 1860 shook it severely, and still later, in 1869, it lost several of its limbs. This is supposed to be the oldest tree in New England, it having been found there a sturdy and vigorous tree, by the founders of the colony. This tree would, no doubt, have perished long since, but for the care bestowed upon it.

In front of the City Hall, New York, stood an old Elm tree, not much larger than its fellow trees, but interesting, from the fact that it had been the gallows upon which several patriots had met an ignominous fate during the reign of Provost Marshal Cunningham of infamous memory. This tree was surreptitiously removed one night, a few years ago, on account of its interfering with the movements of the military, when being reviewed by the civil dignitaries of the city. Within a short time the city has lost another old landmark, the old Varian Buttonwood, which stood on the sidewalk on Broadway, near Twenty-sixth street. This tree was planted between the years 1625 and 1630, thus making it 240 years old. It was the only surviving one of a row which had been planted by one of the old Dutch settlers. This part, of what is now the center of the city was then considered almost as far in the country as Yonkers is at the present day. The old tree became decayed, in consequence of its roots being confined by pavements and stone walls, and was cut down, much to the regret of the old citizens, and the relief, no doubt, of the proprietor of the house before which it stood. If proper care had been taken of this tree, it would probably have stood for another century.

The most interesting tree in New York was the Stuyvesant Pear tree, planted by the sturdy old silver-leg Governor of New York, or New Netherlands, as it was then called. What is now one of the great thoroughfares of the city, and within a stone's throw of the noble Cooper Institute, was then the Bowrie farm of Peter the Headstrong. This tree was imported from Germany in 1647. It blew down several years ago, and its place is supplied by a scion taken from it. This tree possessed great vitality, and was sufficient proof that fruit does not degenerate through age. We have seen it filled with snowy blossoms and fair-looking fruit up to the year of its fall. At the corner of Twenty-fourth street and Third avenue, stood, until the year 1860, a celebrated Willow tree, which had a romantic history attached to it. A friend of Pope's sent him a box of figs from Smyrna. Upon opening the box he found a small twig, which he planted. It grew, and in course of time it became a vigorous tree. When the Revolution broke out in this country, and King George sent his hirelings to crush it, some of his officers came to make a long stay, calculating to take possession of some of the confiscated estates of the rebels. One of the officers brought a few twigs of this Willow from Pope's garden at Twickenham. Upon arriving in this country he soon saw the situation, and as there had been no confiscation of land, nor, in fact, any likelihood of there being any for some time, he presented his cutting to Mr. Curtis, Washington's step-son. They were planted by him, on his demesne in Virginia, and grew finely. After the war, General Gates came to New York, and settled on a farm at a place then called Rose Hill. He brought slips from these trees, and planted one of them at the entrance to his grounds, and there it stood for eighty-four years. This tree was, no doubt, the parent stock of a large portion of what is commonly known as the Weeping Willow of this country.

All readers of American history will remember the romantic incidents connected with the capture of Major Andre. When the brave men, who scorned to be bribed, seized Andre, they took him under a large Oak tree, that stood by the side of the post road leading from New York to Albany, and there searched him, with what results history has told us. Arnold, the principal, escaped to England and died without a friend. The very day the news of his death reached this country, this silent witness of one of the most stirring incidents of the Revolution was struck by lightning and killed.

Long Island is not particularly noted for any celebrated trees. The remains of an old Oak, under which George Fox, the celebrated Quaker, preached, stands nearly opposite the entrance to Mr. Parson's nursery in Flushing. The trunk of this tree measures fifteen feet in circumference, and is supposed to be about 300 years old. The old mansion in which Mr. Parsons resides was built in 1661. It was then a large and vigorous tree.

At Stony Brook, Long Island, there is a Buttonwood tree, which one of our friends measured; it is thirty feet in circumference. The oldest inhabitant of that village died some time ago, and, unfortunately, neglected to leave a record of its age.

On Fulton avenue, in the city of Brooklyn, stood, up to a few years ago, a monster Buttonwood. It was one of the noblest specimens of the Platanus that we ever saw. This variety of tree was held in great favor by the ancient Romans, and, underneath its umbrageous branches, Aristotle, Plato and Socrates held forth to the multitude who assembled to hear the words of wisdom which they uttered. Pliny tells us of one of these trees, that was of such a size that one of the Governors, with eighteen of his retinue, feasted in the hollow of its trunk. One of these trees, growing near Marietta, Ohio, some years ago, was forty-seven feet in circumference, four feet from the ground. Our Brooklyn tree was not quite so large when it was cut down; it measured eight feet in diameter. Mr. Debroise, upon whose estate it stood, stated, in 1848, that when he was a boy, it was seemingly as large as it was at that time; he was at that time nearly ninety-nine years old. The concentric rings, by which a tree's age is determined, were two hundred and seventy-five, as far as we could count; but we should judge it to be at least 300 years old. This tree was, no doubt, the next largest to the Sycamore, which stands on the Seakonnet channel, and is the largest tree in Rhode Island. It measures thirty-two feet in circumference, and is the sole survivor of all the trees which were in that vicinity during the revolution. The only large trees now standing within the limits of the city are three Buttonwoods, on the Jamaica road, near our residence. They are fine trees, measuring twenty-one feet four inches in circumference. These trees were planted by some of the ancient proprietors, years before the city was ever thought of, and when the inhabitants lived in blissful ignorance of political rings.

There are two Oak trees in Salem county, New Jersey, which are noble specimens of this kind of tree. The original growth of timber in this country is nearly gone, but these oaks remain to show the wonderful fertility of the soil. One of these trees, standing on the outskirts of the town, measures twenty-six feet in circumference, and is over 100 feet in height; the other stands in the center of the village church-yard, and its branches cover the graves of those who, no doubt, sought its grateful shade hundreds of years ago.

Among the most celebrated trees of this country that have passed away, was the Charter Oak of Hartford, the sanctuary of the charter of the good old State of Connecticut; in late years celebrated for its wooden nutmegs and hams. This famous tree was twenty-five feet in circumference, and was, no doubt, over 600 years old. Shortly after its fall, relics of it were eagerly sought after, and candor compels us to say the supply was equal to the demand. The Cape Ann Cedar is one of the noted trees of which New England boasts. Fine specimens of the Cedar are to be found occasionally along the line of the New England coast; but this one, in particular, is worthy of mention, growing among a mass of rocks, with nothing more fertile than sea sand, stunted in form, but what it lacks in height is more than compensated for by its strong trunk, of over six feet in circumference. The storms of centuries have passed over it, yet there it stands, a silent monitor to us of what can be done under the most adverse circumstances.

At Shiloh, Cumberland county, New Jersey, there is an American holly (*ilex opaca*), over 100 years old. When we take into consideration that the holly, on account of its slow growth, is rarely used as an ornamental tree, this tree is remarkable. We hope the day is not far distant when the holly will be sought after as a hedge plant.

Many tourists, in passing up the Hudson, have no doubt contemplated with interest the ruins of Fort Edward, a portion of which was destroyed by fire in the year 1756. Close to the water gate, on the banks of the Hudson, stood a Balm of Gilead, or *populus candicans*. It was, up to a few years ago, one of the finest specimens of this variety of tree in the country. It measured, in 1850, twenty feet in circumference at ten feet from the ground. This noble tree was spared from the ravages of the fire when the fort was burnt. Fort Edward, it will be recollected, was also the scene of the massacre of Jane McCrea. The tree under which this took place is passing away.

It was formerly a noble pine of five feet in diameter, but the storms of a century have left it but a shattered relic of of the past.

In connection with celebrated trees, it may not be out of place to give a passing notice to the celebrated Liberty Tree of Boston, which was destroyed by the British during the siege. It stood on the corner of Washington and Essex streets; a fac-simile of it is sculptured in stone, and placed in the niche of the house which is built on the spot where it grew. When it was cut down, a soldier, who happened to be up in the tree, was killed by the fall.

The old Oak at Long Meadows, Massachusetts, under which, tradition tells us, the oldest inhabitants made their treaties, thereby securing valuable tracts of land, for the consideration of a few pewter buttons and elegant strings of pearls and gold beads, made of glass. This noble old tree succumbed last year to the ravages of time and want of care on the part of the civil dignitaries of the town. It was principally interesting on account of its great age. It measured twenty-four feet in circumference, and was supposed to be at least 300 years old.

Massachusetts has been particularly favored in the matter of big trees, if in nothing else. In front of the Watson house, at Spencer, there stood, for 129 years, a noble old Elm. It was so badly damaged by fire when the hotel was burned, that it had to be cut down. It was interesting from the fact, that for a number of years a pair of foxes took up their abode in a hollow of the trunk, and resided there without fear or molestation; a fact which speaks volumes for the ubiquitous small boy and the curs of the neighborhood.

Newburgh prides itself on having a big tree. It is a noble specimen of the Balm of Gilead. It stands on the road to Marlboro. It measures, at two feet from the ground, nearly twenty-four feet, and its branches extend over 100 feet. There is no record as to whether it grew there spontaneously, or was planted by the grandfather of that celebrated individual who, it is said, has no memory of when celebrated local events took place.

An old relic of the memorable battle of New Orleans was cut down a few weeks ago. This was the historic Pine, on the Isle Aux Pois, and well known as the English look-out tree, from its having been used as a post of observation by the English, on their retreat from that disastrous field, where 700 brave men found, instead of beauty and booty, only a grave. This tree, being on the line of a new railroad, was sold to the proprietors of a saw-mill. It was over 100 feet in height, eighteen feet in circumference, and supposed to be 200 years old. The rebellion has furnished us with a few trees which are interesting, from some event transpiring near them. At South Mountain, on the spot where General Reno fell, is a noble specimen of the Chestnut. The trunk of this tree is peforated by hundreds of bullets; yet there it stands, seeming uninjured, marking the spot where a brave man fell.

When Sherman commenced his celebrated march to the sea, he found it necessary, at times, to make observations of the country, and his scouts always selected some large tree for this purpose. At Atlanta, there is a large Pine tree, which is now called Sherman's signal tree. To make it easier of ascent, there are cleats nailed to the trunk, from the ground to the extreme top, a height of some 170 feet. It measures about fifteen feet in circumference. Many of the trees in that section are decorated with what the boys in blue called the Jeff Davis neck tie. These were formed by twisting red hot railroad iron around the trunks of large trees. These collars are not easily removed, and in some years' time, when many of the incidents of the war will have been forgotten, it will be a matter of much speculation as to the object for which they were placed there. The most celebrated tree of the present day is the apple tree at Appomattox Court-House, under which Generals Grant and Lee met to settle the terms which were to send to their peaceful homes thousands of men who had gone to battle for their country.

WAGES OF WORKMEN ON THE FARM.

Mr. H. L. Reade read the following essay: I regard the question of farm wages of great importance. Taking employer and employe, with the families of each, it directly concerns one-tenth to one-sixth of the inhabitants of these States, and indirectly the whole. It involves the collection and disbursement of between one hundred and two hundred millions of dollars within the next ten months. It means loss to several hundred thousand men if they pay more than they can afford, and wrong to as many more if they pay less. Bargaining is already begun in some sections. Within sixty days it will end everywhere. Let us consider it. North of Mason and Dixon's line, for the ten years ending in 1860, twelve or thirteen dollars a month and board for eight months of the year, and eight dollars and board for the other four, was not far from the average of wages received by the best of men. Prices of farm produce in New York, and in most of the markets east of the Alleganies, during these years, ranged about as follows: Beef (for the quarters), nine dollars; pork (in the hog), eight dollars; sheep (apiece), three dollars; calves (live weight), four dollars; lambs (live weight), five dollars; butter, twenty-two cents; cheese, ten cents; eggs, twenty-two cents; corn, eighty-seven cents; rye, one dollar and fifteen cents; oats, forty-five cents; beans, one dollar and fifty cents; potatoes, forty cents; hay, fifteen cents; and other things in about this proportion; each product being more or less affected as to its marketable value by the scarcity or abundance of the crop. From 1860 to 1865 wages advanced from an average of twelve dollars to an average of (perhaps) twenty-seven dollars a month for the summer, and two-thirds that sum for the winter, while during the same time the products of the farm rose in price nearly or quite 100 per cent. While wages were twelve dollars a month, the agricultural condition of the country was one of steady, uninterrupted prosperity. Farmers made a good living, and laid by something nearly each year out of the sure though not large surplus. From 1863 to 1866 they made money much easier and faster than when help was but half what they then were obliged to pay, the principle underlying all such business operations being that the difference between the product of two unequal numbers increased by the same ratio is much larger than the difference between the numbers themselves. Supposing that it requires one day's labor at one dollar a day to raise one bushel of onions worth two dollars, the profit would be one dollar; but doubling the price of labor and the price of onions, and the formula would read: One day's labor, two dollars; one bushel of onions, four dollars; profits on the business, two dollars instead of one dollar, as in the first instance. Since 1866 the price of farm produce has been gradually receding, until in February, 1871, the general average outside of one or two articles is not ten per cent above the prices of fifteen years ago.

Last year wages were not over three dollars in a month less than in 1866, and hence it has come to pass that the year just closed has been not one of disaster, but one of little or no profit to the farmer from the fact that he paid two dollars a day to raise the bushel of onions which only brought him the two dollars cost when put into the market. As to the year now opening, its promise is no better than the realization of the one now past. The west is full of grain; the east is disappointed in the demand for its butter and its cheese. After a drought following the general, if not inevitable, law of compensation, the season is usually good. Manufacturing, upon which in no small sense our markets depend, is far from being over-profitable; in fact, the country, outside of its extravagance, is settling into the old way into which it moved and prospered before the war Taking all these things into consideration, I consider that in the States where the usages of labor are the same as they were before 1860, that from sixteen dollars to eighteen dollars a month and board is all that the farmer can afford to pay for the year 1871 to the best of farm laborers. Working at this rate they can do better than those who were content with twelve dollars or fourteen dollars from 1850 to 1860. Ordinary wearing apparel is but little higher now than then; and although an addition of but $150 a year to one's estate may look small, it will help the honest worker to be content when he considers that this sum put annually at interest at seven per cent for ten years would amount to $1,952.88, with half of which he can begin life on a fair farm and in a fair house in any half dozen of our frontier States. Justice to the employer as well as to the employe demands the decrease that we have suggested, and only by submitting to the laws that govern all business, that capital must return a legitimate income to the owner of capital, whether it be in banks, railroads, or lands. Can the working man put away for the hour, and perhaps foresee, the demand for cheaper labor, which will revolutionize our present system by the introduction of a race who, coming to our shores with less expensive habits, less extravagant notions, can afford to do our work for a fair price?

THE JERUSALEM ARTICHOKE.

Dr. F. M. Hexamer showed specimens of the Jerusalem artichoke, and remarked that it is singular it should have gone out of fashion as it has. Prior to the introduction of the potato it was very generally used as that tuber is now used. The artichoke produces more food for cattle, with less labor and outlay, than anything else. It grows on land so poor as not to yield anything else, at the rate of 110 bushels to the acre. A man could not do better than raise artichokes for hogs and other farm stock. They contain as much nitrogen as potatoes, and animals prefer them. They may be dug in the fall and stored in the cellar, or left in the ground and dug in the spring.

Mr. H. L. Reade.—I have seen the statement that a man down south produced at the rate of 1,000 bushels per acre, and I predict that a few years hence Jerusalem artichokes will be very generally cultivated as a farm crop.

The Turbine Wheel for Farm Work.

Mr. O. M. Hale, Comstock, Mich., wrote, requesting information in regard to water-wheels. The subject was referred to Professor S. D. Tillman, of the Polytechnic branch of the American Institute, and he submitted the following reply: "To run the mill with less water than is now used, no wheel can be substituted for the overshot except the best form of French turbine, which has been proved, by experiments, to be the most effective wheel yet devised. It is made of cast-iron, and is cheaper than the overshot. Running equally well under or above the water level, it is never stopped by a freshet. It consists of a series of curved buckets placed on the upper side of a circular plate rotating horizontally; the water is directed to the buckets by a series of curved guide plates. These percussion wheels have been greatly improved at Lowell, Mass., and at Philadelphia, Pa.

The Fence Question Discussed.

Mr. John W. Niman, Spring Mills, Ohio.—I have tried hedging and seen ditching enough to satisfy me there is a cheaper and better way. Even at the present time fencing is too expensive to be followed any longer. From a boy up I have given this subject considerable attention. I love to see good and handsome fences. I have got nearly 125 acres under stake and ridered fence, in lots ranging from five to twelve acres each, but when I count the cost it is entirely too great. It requires about 50,000 rails and stakes, built in fence, at an approximate cost of $3,000. Then the interest per year, $300, with the land occupied with this fence, not less than ten acres, at seventy-five dollars per acre, with interest on same, making $825, making a sum total of $4,125. Add to this fifty dollars per year for repairs. Now, this is too expensive. Nor is this all. The fence rows are harbors where briers, elders and weeds will ripen and spread over the rest of the farm. There are two ways more economical. The first is to fence *in* your stock instead of *out*. And let the farming and timber land lay to the commons, then the land would be free from encumbrance, and consequently more convenient to work. By marking the boundary lines of roads, every farmer might have enough more land to work, by coming to the boundary of the road, to produce enough to pay his tax, where he is now paying tax on land that he has little or no use of. When it becomes necessary to change pasture ground, two good men and team can remove the fence of ten acres in five or six days. This will not be required but once in two or three years. The question may be asked, how can we pasture other grounds after harvest? This is an important question, and should be more carefully considered. In my experience I find pasturing land too bare a common practice, and doing great injury to the land, therefore, it never should be done; it is of more value to be left on the ground. My second plan is to herd the stock. The interest of the money to keep up fencing, to say nothing about the many other advantages, is sufficient to hire a shepherd. This is an important subject, and receiving attention by many thinking land-holders.

Adjourned.

February 28, 1871.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Cultivation of Peppermint.

Dr. E. Ware Sylvester, read the following paper:

At the mention of peppermint oil you will doubtless smile, as in your minds it is probably associated only with the dose given to infants, or it may be with peppermint candy and lozenges. But you will, perhaps, be pleased to learn that it is an important farm product, and serves instead of gold to pay our foreign indebtedness. There is sold annually, from a region within ten miles from my residence, $500,000 worth of peppermint oil, a large proportion of which is consumed in England and on the continent of Europe, and this oil is the product of land nearly worthless for any other crop except willows, and one-half of the labor employed is that of old men, women and children, which cannot be made available to a large extent on a farm; hence the mint-grower, instead of making two blades of grass grow where one grew before, makes bright dollars grow where none grew before.

Soil.—The soil best adapted to the growth of peppermint is the half-drained black ash swamp which has been cleared of timber, as these are usually, in our vicinity, made of black muck from two to fifteen feet deep, sometimes with a slight admixture of other soils, the mint seems to be perfectly at home in them. River bottoms which are quite moist are the soil next in value, and upland the poorest. I think the crop seldom pays on good corn land.

Preparation.—Sometimes the swamp is only cleaned of stumps, plowed, dragged and mint immediately planted; sometimes the land has been used for pasture while the stumps have been decaying, and this is plowed in the fall or spring, dragged, and the mint immediately planted.

Digging.—In order to plant we must have roots; these must be one year old, or roots from which only one crop of mint has been cut. The roots are usually lifted with a mint-hook, with three or four prongs set nearly at right angles to the handle; these are placed in piles similar to a small haycock, where they can remain only a short time, as they would soon lose their vitality; sometimes they are slightly covered with earth, in which case they will keep longer.

Planting.—The land having been thoroughly dragged, a small plow marks out the furrows for the reception of the mint; they are from fifteen inches to two feet apart, according to the fancy of the planter, usually about twenty inches; it is very important that these rows be perfectly straight, as it diminishes very much the future cost of cultivation. The depth of the furrow is from three to five inches. The roots are then strewn along the furrows by boys or women in such a manner that there are about three roots abreast of each other in the furrow, and forming nearly a continuous line. This is very rapidly performed, about one-fourth as fast as a man would ordinarily walk; a man or boy follows and with a hoe covers the roots; sometimes they are covered with the feet instead of the hoe, if the soil is very mellow. The time of planting is in the fall, a few weeks before the ground freezes, or early in the spring; most of the mint is spring planted.

Cultivation.—When mint is planted in the spring, the tender shoots soon show themselves above the ground, and the crop is then hoed, with or without cultivation by a mint cultivator. Here is an important point, the weeds and grass must be thoroughly eradicated or the future labor is immense. The crop is usually cultivated twice and hoed three times by thorough mint-growers.

Harvesting.—When the cultivation has been thorough, by the month of August, the mint has completely covered the ground, and stands erect, from eighteen inches to two feet high, and with its dark green leaves and purple blossoms entirely conceals the earth, and as it sways in the breeze, is one of the most beautiful sights the farm presents. The blossom indicates that the time of the harvest is at hand, and just here good sound judgment is money, for it often makes one-half the difference in the yield of oil, if the mint is cut too late or too early. It is usually mowed with a scythe, sometimes with a machine; left to wilt a day or part of a day, according to the state of the weather, then carefully raked or forked into small cocks, and after a day, two of these cocks made into one. The point aimed at is to keep all the leaves on the stems, preserve them from the sun and rain, and reduce the mint to the smallest compass for distilling. Careless handling at this stage is disastrous. The second year the mint is neither cultivated nor hoed, and as the grass which grows yield no oil, the mint and grass are cut together and distilled. The yield of oil is usually the greatest the first year, but sometimes the reverse. In very rare instances the field is mowed the third year without replanting.

Distilling.—Having detained you so long with the description of the growth I shall defer the details of the distilling until another time, if in your judgment such details would be interesting and profitable, merely adding that the peppermint oil is obtained by placing the mint in very strong tubs, made steam-tight by patent rubber bands, and steam from a boiler passed through under heavy pressure, the steam cooled by a worm immersed in water, the oil and condensed steam separated by a peculiarly formed tin apparatus. The oil is placed in tin cans holding about twenty pounds each, and is marketed by the grower in this form.

Prices.—Peppermint oil was quoted in last Wednesday's papers at $3.25 to $3.50 per pound. I sold my crop in 1868 for $4.50 per pound, and some obtained $5.25 at a later period. But just now the war in Europe seriously interferes with the trade. Most of the oil grown in Wayne county is sold in Lyons, refined, labeled, bottled, and sent abroad in this form at an advanced price. All or nearly all the prizes offered at the grand expositions of London, Hamburg, and Paris, were won by Messrs. Hale & Paishall and H. G. Hotchkiss of Lyons, N. Y. Their European orders are very large, and their brands favorably known throughout the civilized world.

Profits.—These will depend upon the adaptation of the ground to the crop, the knowledge, skill, and energy of the grower, and the price obtained. At $3.50 to $4 per pound it is a good paying crop. In 1868, a very favorable year for mint, I had two acres which yielded thirty-two pounds to the acre, sold at $4.50 per pound. The profits of the crop were $100 per acre. In the autumn of 1868 I plowed an old lowland pasture of twelve acres, planted seven acres in the fall, and the remainder in the spring. That planted in the fall produced the most mint per acre, both in 1869 and 1870, the average yield of the whole being thirteen pounds of oil per acre in 1869 (a very poor mint year), and twenty pounds of oil in 1870. I estimate the profits at $25.00 per acre, each year the oil being $3.00 per pound. There are some crops reported at forty pounds to the acre, but probably the land was not measured by a surveyor. On the other hand I have seen land not adapted to the crop, poorly planted, tended a week or two after the appropriate time, and handled badly, which I was entirely satisfied did not pay twenty-five cents per day for the labor expended upon it. The whole question of profits may be answered in a single sentence. A crop of peppermint oil sold at $3.50, which has been well fertilized with the aid of brains, will pay well; without brain-work it will be a loss.

Lice on Peach Trees.

Mr. Clark Hewitt, Saratoga Springs, N. Y., asks how to kill the lice without injuring the plants.

Dr. Isaac P. Trimble.—A perfectly-saturated solution of tobacco.

Dr. Sylvester.—I covered the top of a small and choice peach tree with newspapers, and then smoked under it a good Havana cigar. The lice were destroyed, and the growing peaches not harmed.

Mr. A. S. Fuller.—A good way with small plants is to set some tobacco on fire in a barrel and hold the plants in the smoke. Tobacco, by the way, will do for the lice and is very effective, but it will not affect the red spider, a kindred nuisance.

Milk Houses.

Mr. Joseph Richard, Charlotte, N. Y.—I am a young farmer; have before sent my milk to a cheese factory, but think I shall make butter this year. I have 100 acres. Shall I make a milk-house of wood? Shall I have a plank floor, or concrete?

Mr. J. B. Lyman.—Not of wood. If it is thick enough to be cool, the walls will be damp and smell bad and rot fast. Build of stone, have it right over the spring, grout the inside, whitewash as often as mould appears; cement floor, with a little raised platform of oak plank to step on. Have the water three inches deep, except in one place, where it should be a foot deep for the cream pails.

Grain and Salt and Flavor in Butter.

Mr. Homer Hecot, E. Watertown, N. Y.—Many people adhere to the old notion that if butter could be made pure that it could be kept sweet any length of time without salt. Several years ago it was thought that if butter was perfectly purified from all moisture that it could be kept sweet any length of time; accordingly they tried the experiment of melting and found that it became rancid sooner even than that which had never been salted. After churning and working the butter right, then work in the salt quickly and evenly, as this will prevent it from being streaked. If it is about the grade of Onondaga dairy salt there will be scarcely a particle of butter that does not come in contact with the salt; and now the butter must be packed or made into rolls immediately or the salt will begin to dissolve. It will not even do to allow time for the salt to dissolve before packing, as pounding it down will displace the brine. This brine forms the grain. If you wish to see the beauty of it take a knife, cut out a piece and break it apart, take a magnifying glass and you will readily see that each particle of brine is in the exact size and shape of the salt before it was dissolved, and this, after forty-two years' experience in dairying, the writer had found to be the only method of keeping butter sweet a suitable length of time. Human ingenuity has thus far failed to discover any method of keeping butter or any other fatty substance from becoming rancid. It is a first step toward decay or decomposition, and is as much a law of nature as that water, if allowed, will run down hill. Lard, tallow, all kinds of oils come under this rule. The old plan was to work the butter thoroughly after churning, then mix in the salt, set it away for twenty-four hours, then work it again until no moisture is discoverable, and pack it. The butter is then very nearly fresh, and there is nothing to prevent it from becoming strongly rancid in from four to six weeks. It is, in fact, no more nor less than a salvey, sticky, greasy substance. The best use it can be put to is to slush the spars and rigging of vessels, and much of it is used for that purpose. I often ask my neighbors if they do not find their butter too fresh after working over. They say yes, but we then add more salt. Very true, but the first dose of salt has withdrawn all the moisture, and there is nothing to dissolve the last salt, and it remains whole in the butter, and whole or crude salt has no preservative quality for butter, meat or anything else. It is sometimes used as a non-conductor of heat for an outside packing or covering, as in the case where each firkin was put in the middle of a barrel of salt. It is very easy to work moisture out of butter, but it cannot be worked in. The grain is broken, gone, and can never be reinstated. Some of our neighbors say we work our butter over a little the second time, but not too much for fear we shall break the grain. Let us see how that operates. Your particles of brine at first are exactly the size of the grains of salt. Work it a little; how are they now? Two or three have gone into one. They are now the size of a wheat kernel; they will soon be the size of buckshot. During the little working all the globules that have been brought to the surface have escaped. Let us see if you can put one of them back again. The question naturally suggests itself: Why spend your time and strength to put salt into the butter and then work it out again, at the same time reducing the worth of your butter from five to ten cents a pound, and lessening the weight of the butter at least five pounds on the hundred?

My plan of washing butter is probably new. I use a plain crank-churn; goes by hand; average time, twenty minutes for large, twelve for small churnings. I do not claim to make more or better butter from the same cream than with a dash-churn, but I do claim that I can do the work with one-half the time and labor. Much of this saving is caused by the convenience of washing, getting rid of the buttermilk-water, and in working the butter. As soon as I discover that the butter begins to separate, I put in a quart of cold water; this is to thin the milk, which will cause it to free itself more readily from the butter. I then churn until the particles are about the size of a large pea. I then draw off the milk and put in a gallon of water, churn, and draw again, and sometimes put in one more washing. The common way is to churn until the butter is about one solid mass; but how is the water to take effect on the inside of these large lumps of butter? I should about as soon think of washing the inside of a glass bottle by washing the outside.

I think that in order to make the most and best butter in hot weather it is particularly necessary to cool the milk immediately after milking. Milk in tin pails; have a tub similar to a wash-tub for each pail; set the pails in the tubs filled with cold water from a good spring or well; stir the milk and the water every few minutes till the milk is about as cool as the water. If you can get the milk quite cool before setting, and set shallow in pans, it is better not to let the pans stand in water while the cream is rising, as the cream will be all up before the milk becomes very thick. Skim as little milk as possible with the cream, as that is the great secret about quick churning.

Profits of Pork Raising.

Mr. P. P. Paddock, Malone, N. Y.—I want to report my pork record, and if there has been a more profitable old mother hog slaughtered this year, I shall be glad to hear it. I took her from grass the 20th of last September, and commenced feeding her boiled corn. She then weighed about 300. She ate twenty-five bushels of corn in ninety days, and when I slaughtered her on the 24th of December, her dressed weight was 607 pounds. That sow had raised seven litters of pigs, numbering sixty in all. These pigs were sold at the age of four weeks for an average of five dollars each; $300 from her pigs. Of her last litter, dropped the 26th of April, eight were fatted. One at the age of seven months, twenty-one days, dressed at 406; another at eight months dressed at 409 pounds. Of the eight pigs fatted I believe none have dressed less than 300 pounds, and from that to 409 pounds, according to their age when slaughtered, and the skill displayed in fatting them. These pigs were full blood Chester Whites, and I judge that for making large, fat pigs, at seven or eight months old, there is no breed better. I think there is no way that pork can be made to be good and cheap as from pigs of the right breed crowded with cooked corn-meal and sour milk from the age of four weeks till about eight months old. Pigs for fatting should be dropped in March, so they can be finished before winter. I judge that a given amount of feed will make one-fourth more pork in warm than in cold weather, and that a given quantity of corn will make a fourth more flesh if cooked.

BRIMSTONE FOR THE RED WEEVIL.

Mr. M. H. Boye, Coopersburg, Pa.—In 1869, about fourteen bushels of wheat, which had been kept over from the preceding year, was in August placed in the same bin with the newly thrashed wheat, but on top of it. In the latter part of November it was discovered that the wheat had become hot, and upon further examination it was found in the middle of the bin a considerable portion of the old wheat had caked together, being moist and mouldy, the whole having a peculiar disagreeable smell. A great number of very small brown beetles were found all through the wheat, both old and new, and were the cause of the heat which pervaded it. This heat had caused the moisture to pass and condense in the upper and middle part, causing it to become moist and mouldy. This latter part contained also, beside the small brown beetles, innumerable still smaller white animals, which were about the size of hen-lice. The rye, which was contained in another bin, had also become heated, though less so, and contained the same small brown beetles. As soon as the granary was empty, it was thoroughly swept and then fumigated with sulphur. For this purpose about two ounces of roll sulphur was melted in a pie-dish by placing it on top of the stove, not exposing it to the free fire for fear it might become ignited, which would be dangerous on account of the fumes, which might overcome the operator before he could escape from the room. As soon as the sulphur became melted the dish was removed from the stove, and coarse linen or canvas rags of the size four by two inches pushed through it, one at a time, using a small stick to keep it down in the sulphur, which thus penetrates it and solidifies as fast as the rag is drawn through it, covering it completely with a thin layer. Eight or ten of these sulphur-covered rags were fixed each in the cleft of a small stick six inches long, the other end of which was pointed and placed in an ordinary three-gallon iron pot half filled with sand or earth, leaving the rags supported at a small distance from each other. For still greater security this pot was placed on an old waiter, and this whole affair placed on the floor in the middle of the granary. All openings in the granary having been stopped up, the sulphur rags were ignited and the door shut tight as a further precaution; the operation of the burning of the sulphur rags was watched through the window from the outside. The sulphur having become extinguished, the granary was not opened till the next day. It was then scrubbed with hot soapsuds, introducing the hot water as much as possible into the cracks and corners. The window was then left open the whole summer until the fall (1870), when the new grain was put in as usual. Up to the present time, February, 1871, the beetles have not reappeared. It is not unlikely that by careful cleaning and airing, the same result could have been obtained without the fumigation by sulphur, which though undoubtedly very effective, must always be considered more or less dangerous in a barn. As a general rule all such insects are got rid of almost to a certainty by cleaning out everything that can serve as food for them, and keeping the place in this state for a sufficient length of time, by which they either forsake the place or are starved to death.

Bee-keeping.

Mr. Jasper Hazen, Albany, N. Y., sends the following account of his attempts at bee-keeping. He says: "There are certain facts relating to bee-keeping proper to be taken into account by the bee-keeper.

"1. Bees in a hive of only 2,000 cubic inches will double their numbers annually by swarming, until they exceed in numbers the capacity of their field for supporting them, then a large portion of them will starve to death in winter. There have been two winters since I commenced bee-keeping in 1860, in which more than three-fourths of the colonies in a circuit of several miles starved to death.

"2. Begin with one colony; with the first year's swarming you have two; second year, four. Doubling every year for ten years, you reach 1,024 colonies of bees.

"3. Every field must have its limit somewhere between the two hives or colonies of the first year and the 1,024 colonies of the tenth year. Exceed that limit, and the bees are weakened, many of them perish, and the owner gets little or no surplus.

"4. Some fields will sustain 100 colonies, some fifty, some ten, others not more than four or five. Every bee-keeper should be able pretty definitely to understand from experiment the capacity of his field, and limit the number of his colonies to its capacity. Failing to observe this rule, I had a neighbor who twice within five or six years has been reduced from thirty colonies to four in one winter, and from thirty to two colonies last winter. Keeping bees in this way is worth but a little to the owner or to the public.

"5. The profits of bee-keeping depends more upon the amount of surplus honey secured than upon the number of colonies of bees standing in the apiary. In the past season five colonies of bees gave me 629 pounds of surplus, in small sized boxes. One of the five gave 200 pounds. This was almost entirely from white clover.

"6. I don't know that bee-keepers have over estimated the difference between the amount secured and the expense at which it is secured in the different classes of hives. In the small swarmer hive, Mr. Quinby estimates the surplus at one dollar's worth in his first edition, to each old colony. In his second edition he estimates it at two dollars' worth, and says in some seasons it may amount to five dollars. If we reckon it worth twenty-five cents per pound, this would be from eight to twenty pounds. This is for the old colony and its new swarm. Call it ten pounds.

"7. It will then take twenty old colonies to give 200 pounds of surplus. There will be the cost of twenty hives of bees of the old colonies and twenty new swarms at five dollars each, $200; forty hives at one dollar each, forty dollars, making an outlay of $240. The cost of the boxes may be omitted in our estimate, as their cost for holding the same amount of honey will be equal in both classes. The average of the five hives that gave me the 629 pounds is about 126 pounds.

The cost of five hives of bees is..........................	$25 00
Five hives at six dollars each is	30 00
Outlay for 629 pounds of honey..........................	$55 00

My hive that gave me 200 pounds, the cost of one hive....	$6 00
One swarm of bees..........................	5 00
Outlay for 200 pounds by one hive	$11 00

"But this is more than the cost of the honey. Bees will average four years labor, and hives well painted will last twenty years.

Then take one-fourth the cost of the bees	$1 25
One-twentieth cost of hire	30
And one year's interest	77
Cost of 200 pounds of honey	$2 32

"Cost per pound, one cent and sixteen-hundredths.

"Cost of 629 pounds from five hives:

One-fourth cost of five swarms	$6 25
One-twentieth cost of five hives	1 50
Interest on outlay	3 85
Cost of 629 pounds from five hives	$11 60

"Cost per pound, 1,531-629 cents, nearly two cents per pound.

"The cost of 200 pounds in the swarmer hives is:

One-fourth cost of swarms	$50 00
One-twentieth cost of hives	2 00
Interest on outlay	16 80
Cost of 200 pounds of honey in swarmers	$68 80

"Cost per pound, thirty-four cents and four mills.

"If we leave out the new colonies the cost per pound will be but half as much. But as long as bee-keepers refuse to sell their bees, and keep increasing them until the winter kills them off, and then begin again with the few colonies that are left to repeat the same operation over again, the whole should stand charged on the debtor side. I know not why this is not a fair estimate of the cost save the price of boxes, which is equal in both cases, and their cost is returned in the sale of the honey. Which gives the least care and trouble judge ye.

"8. Another estimate, that I have never seen noticed in the books, is worth some consideration: A colony of bees will require, for the breeding season and winter, sixty pounds or more; it will require, for the forty colonies, old and new, 2,400 pounds; they give, in surplus, 200 pounds; they consume thirteen-fourteenths of the product of their field; and the keeper gets but one-fourteenth. The five colonies, that give an average of 126 pounds in surplus, give a little more than two-thirds in surplus, and consume but one-third. The colony that gave

200 pounds in surplus consumed but one-quarter, and gave three-quarters in surplus.

"9. It should be remembered that these results are from the appliances afforded them for the prosecution of their business, with abundant room to remove all disposition to swarm. The whole time is given to gathering and storing honey.

"10. The field gathered by the forty colonies, old and new, must give 2,600 pounds of honey; ten colonies in the best hives will gather it, consuming 600 pounds, and giving 2,000 pounds in surplus; put twenty colonies in the large hive in the field, they can only gather the 2,600 pounds, consuming 1,200 pounds, giving only 1,400 pounds in surplus. It is necessary, by careful observation, to learn the capacity of the field, and place harvesters in it according to its capacity."

Adjourned.

March 7, 1871.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

WINDBREAKS.

Mr. C. Adcock, Jr., Confidence, N. Y.—I would like to be informed what plant makes the best windbreak.

Mr. C. D. Bragdon.—Norway spruce.

Dr. E. Ware Sylvester.—Arbor vitæ.

SOLUTION FOR PINE SHINGLES.

Mr. L. S. Winsch, Gnadenhutten, O., wrote that he had received the idea that pine shingles saturated in strong salt brine previous to putting on roofs would make them proof against fire from sparks. He would like the opinion of the Club.

Prof. J. A. Whitney.—No practical advantage. Wouldn't pay for the trouble.

Dr. E. Ware Sylvester.—The plan was tried on a bank built in Lyons. It was found that the salt acted on the nails, which soon rusted off and left the roof in a leaky condition.

Prof. H. D. Colton.—I have known a wash of lime to be applied after the shingles were laid, and with advantage. It prevents accumulation of moss, to say the least.

INVENTIONS IN AGRICULTURE.

The Chairman.—The stress of ingenious thinking applied to the improvement of farmers' tools within the past score of years is something amazing. The records of the patent office would seem to indicate that half of the inventive brains of the country are enlisted for the tiller of the soil, sympathizing with his labor, and studying how he may do his work easier. When Polk was president, the number of agricultural patents issued per working day was about one on an average. Now the daily average is seven. The brilliant success of the reaper and mower gave impetus to ingenuity, and every sort of rural toil on all farms and in all months of the year, has been abridged or modified, or wholly superseded by some cunning device.

The following statistics of patents granted in the agricultural department during the year 1869:

Churns and churning	130
Corn shellers and huskers	40
Cultivators	150
Diggers and spaders	30
Fertilizers	6
Forks (hay, manure, etc.)	100
Harrows, drags, and pulverizers	80
Harvesters and attachments	195
Hay spreaders	25
Hoes	25
Mowing and reaping machines	30
Planters	150
Plows and attachments	255
Pruning	15
Rakes	90
Seeding and sowing	80
Separators and smut machines	50
Straw, hay, and fodder cutters	30
Thrashing machines	35
Yokes	15
Total	1,900

Mangel-wurzels, Swede Turnips, and Altringham Carrots.

Mr. William Crozier, of Northport L. I., sent from his Beacon stock-farm, samples of roots of mangel-wurzels, Swede turnips and carrots, with the following explanation and suggestions: The roots were picked out of three carts coming from the pits, to be used on Saturday. We can raise as good roots here as in England or any other country if we only understand how to do it, and roots are what is needed for the promotion of our agricultural welfare. The more roots we raise the more stock we can feed, and the more stock we feed the more roots we can raise, and now is the time to prepare. Pile up the manure, plow deep, drill out the land in deep furrows, and do not count the manure by the car-load, but fill up the furrows with manure, spread evenly, and cover with a ridge plow, and roll hard with a roller; then sow your seed with a seed-sower, putting at least four pounds of mangel-wurzel seed to the acre; three pounds of carrot seed, and three pounds of turnip seed will be sufficient for the acre. You will find at R. H. Allen's, 191 Water street, New York, seed of the above kinds, also seed-sowers, drill plows and rollers. His seeds you can recommend, as I have used them myself, along with seed I imported, and could not find any difference. I have several times purchased seed from some seed stores which did not give me satisfaction, and if seeds are poor your entire crop is a failure.

COOKING FOOD FOR ANIMALS.

Dr. J. V. C. Smith read the following paper: Progress in any department of science simply means a more perfect acquaintance with natural laws. Throughout the domain of nature there is order. It is impossible to change those processes on which the general harmony of the mineral, vegetable, or animal kingdoms depend. Man, by his ingenuity, may interrupt functions and modify tendencies on a very limited scale, but that is only temporary in its effects. Water will always run down an inclined plane, and heat expand vapor, while the constitution of the globe remains the same. By untiring determination to counteract those laws which characterize the external form, habits or instincts of animals, there may appear for a time to have been a permanent success. But a relaxation of the measures adopted for achieving the purpose contemplated is invariably followed by a reaction that is nothing more than a return to a normal condition, which is the distinguishing characteristic of the race to which individuals, the subjects of experiment, belong. It is one of the misfortunes of modern agriculture, advanced in our day to the dignity of a science, that it is embarrassed with many theoretical speculations which interfere with pecuniary advantages, the very object contemplated in departing from rational principles based on the common experience of mankind. Forcing is not development in the sense attached to the idea of perfection. Fruits may be so acted upon by artificial means as to become monstrosities. By persistent effort, roots may also be immensely enlarged, but they cannot be kept at that point independently, if those influences on which their large dimensions depend are withheld. Vegetation and animals have a normal standard of form, but any deviations from a general law in respect to weight, strength, muscular force, fatness or leanness, are referable to incidental circumstances, as the quality of their food, the season or the hardships to which they are exposed. Let conditions be what they may, famine in one direction, or excess of nutrition, each infallibly oscillates back at last to the original type characteristic of the family of which they are genuine representatives. Plants may be dwarfted, but, if left to themselves, they will ultimately regain their original stature. On the other hand, those enlarged entirely beyond ordinary dimensions, return to their normal size and character when left to themselves. Carnivorous animals may be sustained on vegetable aliment for years; but individuals thus trained exert no permanent influence over their offspring in respect to the law of their nature, which imperiously demands flesh for food. They are born with an appetency for it, and their digestive apparatus is constructed mechanically for preparing such food, and no other, for developing the highest qualities of their organic structure. Gramnivorous quadrupeds may be compelled to sustain life on animal food, and that for long periods. Thus, cows are fed on fish exclusively in Greenland. Of course, they are imperfect specimens, diminished in size, and their milk is an impoverished secretion, vastly inferior to that from cows fed on grass. Whenever they can they seize with ravenous avidity vegetable food, which is simply in conformity to a law which adapts means to ends for the accomplishment of specific designs. These propositions open a way for the consideration of a question of importance to the farming interest everywhere, since profit is the stimulus in successful agriculture. Among the many ways of making much out of a little in the shortest time, that of rapidly forcing swine, cattle and poultry to extreme fatness is receiving very marked attention, quite beyond what the subject merits. No arguments could be adduced which have not repeatedly been urged in this society, to show that excessive fatness is a disease. A certain amount gives a graceful outline and completeness to the form. The softness and pliability of the muscles and tissues is due to the secretion of adipose matter in appropriate cells. When in excess it becomes a burden to man or beast, abridging the full expansion of the chambers of the heart and the distention of the lungs. Mechanically considered, the conditions of man and the animals associated with him are the same. Aboriginals are rarely obese. On the contrary, they are simply muscular. Wild animals, in their unrestrained liberty, are beautiful, but not fat, as we associate that quality with what is denominated the best marketable meats. They are exempt from nearly all those diseases to which domesticated animals are predisposed, having neither glandular swellings, ulcerated livers, or vitiated fluids. It is also certain they are free from scrofulous tumefactions or abnormal enlargements of the viscera, to interfere with the performance of those appropriate functions on which vital force positively depends. Imprisonment in a pen is a first step toward excessive fatness. In those parts of Africa where girls are fattened to enhance their value, no exercise is permitted. They are compelled to swallow vast quantities of milk, oily nuts, etc.; and thus an elevated standard of beauty is attained. Such results could not be gained were there any friction of mind. Mental activity declines in exact ratio with the increase of fat with those whose intellectual powers were dormant at the commencement of the process. Bruce, the traveler, gives an account of three women, wives of an African king, distinguished for all that makes a lady charming in the estimation of the people whom he visited, each of whom weighed over 400 pounds. Shakespeare perfectly understood the misfortune of too much fat:

> "Dainty bits make fat the ribs,
> But impoverish quite the wits."

Calvin Edson, the so-called living skeleton, was an extreme case of absolute absence of adipose material. There was not enough for giving suppleness to the cordage of his body.

Wild animals, simply made prisoners, cannot be fed to fatness with much success. Their offspring, however, can be improved in that respect, if fattening is so regarded. All animals below man require food as nature prepared it for them—cold, that is, regulated by the temperature of the season. If obliged to subsist on that which has been cooked, the elements on which their healthy condition depends are not improved by being heated. New chemical combinations are elaborated, injurious to them. Their teeth and stomachs are both deranged by artificially prepared food. Both perform their functions best when there is no departure from their instinctive habits. A determination to abolish nature's laws and establish a code of our own, is an useless expenditure of industry. A few heroic theorists may attempt very decided revolutions in rural economy by baking, boiling, steaming, mashing or cutting food for their horses, cows and swine, but all such efforts are the measures of enthusiastic individuals which will never be generally adopted. They conflict with the laws of organic life as constituted in the lower races. A good farmer, actuated by an honest conviction that he is pursuing an enlightened system of economy, may become the servant, slave and cook of a family of pigs, but it is a wide departure from the dignity of his mission, and a violation of law on which the healthful perpetuity of his herds and flocks depends. Making money out of an infraction of the law, is no justification for persistence in doing wrong. A resolution to thwart nature by the appliances of art, was finely ventilated by an epigramatic poet:

> "*Naturæ duce* was the text
> Of good old Hippocrates;
> But we shall lead old nature next,
> The force of art so great is."

The position assumed in this argument is this, viz.: That a condition of symmetrical rotundity, not inconsistent with vigorous health, is a measure of fitness for human good; when the fattening process is carried beyond that point, the animal is then forced into a diseased state. There are various maladies peculiar to civilization which unquestionably have their origin in diseased meats sold daily in the stalls. It is both known and unhesitatingly admitted that cattle and swine transmit their diseases to their descendants. Calves only a few weeks old have ulcerations, and their flesh, therefore, cannot be wholesome food. We cannot particularize the effect it produces when commingled with our own blood. The science of medicine has still an unexplored field for observation in that direction. Wild animals have no such hereditary taints. By cooking vegetables, as grain, potatoes, etc., their flavor is destroyed and their properties modified, so they are not relished by animals as when fresh and natural. Left to themselves, they invariably abandon artificially prepared food for that which is most agreeable and suitable for them in the constitution of things. The more nearly and exactly we follow nature, the more successful we shall be, because the laws she has established cannot be violated without producing results injurious, if not destructive in all their bearings. Notwithstanding the prodigious mistake of carrying a fattening process to that excess that makes animals a burden to themselves, the quality of the flesh is not enhanced by it either in quality or rapidity. We do not cook either lard or tallow. Neither are they table luxuries. Their utilization as human food is in sparing combinations with other articles. A certain degree of harmonious plumpness, indicative of perfect health, pre-supposes the deposition of adipose material in sufficient quantity for the protection of an animal, as a non-conductor of caloric, and to provide for the lubrication of the viscera in the great cavities of the body, and provide for the easy play of muscular fibers. When in that condition, the properties of their flesh are wholesome and most nutritious for human food.

If their obesity is urged by the appliances of art beyond that rational standard of development, there is a loss in the quality of the tissues for the purposes contemplated. And there is a loss, too, in another way. Thus, a very unusually fat animal, owing to a mistaken estimate of value placed upon that condition, sells for more than one of ordinary marketable appearance; but the tallow in the one, or the flakes of lard in the other, bring no more than the same material taken from a common animal. But as the price for the whole carcase by weight is quite beyond the ruling prices, for example, based on the imagined superiority of steaks and sirloins taken from their connection with mountains of fat, is a fallacy; it being no better, and perhaps not quite as good. The consumer pays dearly, too dearly for it, misled by a false estimate of both parties on its dietetic qualities. Desirable as it is from pecuniary considerations to carry the fattening of domestic animals and poultry to a point that, if extended a little, further would suffocate them in their own fatness, if they do not fall by apoplexy, in a sanitary view, is to be deplored; deplored, because their flesh possesses no increased nutritious properties; but oftener than otherwise conveys in its unnaturally distended cells the germs of disease, which the vital powers of the human system cannot always resist. An enumeration of the evils traceable to improper food, in the catalogue of maladies afflicting our civilization, would become a distinct volume. No such enterprise is contemplated; but it is admissible to advert to the fact that communities are frequently alarmed by the outbreak of anomalous epidemics or sporadic exhibitions of familiar diseases in an aggravated form that defy medication. Such sanitary phases are mainly to be referred to the character of food on which those have fed who are the sufferers. Subtle poisons, fatal in their influence, conveyed into the human stomach, may have been generated in diseased meats. And these are produced by the mode of treating the animals, since wild ones, game, etc., received as choice and most desirable human food, is neither diseased, or do those sustained upon it habitually have the amount of indisposition incident to all villages, towns and cities in christendom. Were any of the lions, tigers, jackals, elephants, camels, vultures, etc., at the Central park put upon cooked food, abandoning such as they crave in a natural state, no one doubts it would be a hazardous experiment and ultimately fatal. Would it not be ridiculous to serve a broiled steak to the king of beasts, or prepare a boiled pudding for the camel? Has the domestication of cattle and swine changed their internal organic structure, fitted for the reception of vegetable food just as it is prepared by mother earth? If cooking that food which they prefer, because it contains elements essential to their growth, strength and health is not necessary, is there not valid reason for believing there is danger of doing them harm? If left to their choice, not a particle of artificially prepared nutriment would be touched. Instinct guides them in paths of safety. Necessity compels imprisoned swine and stalled fed kine to take what is given or have nothing. After that, a morbid appetite is developed for that which is doing them an injury. They have neither language for complaining nor judgment for restraining them from excess when the morbid craving has gained ascendency. A drunkard under the awakenings of a debilitated conscience, knowing he is wrong and endangering reputation, credit, and even his own life, gives way to the demands of a vitiated stomach. Thus, then, it is susceptible of proof that, going counter to those permanent laws by which any or all of the lower animals are sustained, tends to their discomfort, injury and premature death. The same principles of reasoning are applicable to domesticated animals in the service of man. While traveling over various parts of Italy in a vetturino, which was hired for the purpose and drawn by the same horses, the driver usually feed them in the middle of the day on large loaves of barley bread. But I noticed they much preferred food more consonant to their nature. He contended baked bread was as much better for horses as baked bread was better for ourselves than the dry grain of which it was made. The argument was neither sound nor remotely philosophical. Had he had the slightest conception of the anatomical peculiarity of the digestive apparatus of the horse and man he would have seen there is no parallel between the two, and hence would have given his fatigued horses what they preferred, rather than waste baiacchi on baked bread, which they swallowed under a protest, if they could have said anything on the subject. A horse has no gall bladder; man has, and he is omnivorous; a horse is graminivorous, and is neither obliged nor benefited by having any other food than grass and grain. Finally, without dwelling pertinaciously on points which no more require evidence to sustain them than that further proof is required by doubting people to convince them the sun is the center of the solar system, it is assumed to be true that cooking the natural or any food for cattle or swine, is not only unnecessary, but to their injury. Violation of physical laws to their detriment, reacts to the certain injury of society, inasmuch as diseases are engendered and propagated from such sources. In these deliberations on the vital economy of domesticated animals, only a reference is made to those terrific parasites, tape-worm and trichnia, which, developed in the flesh and intestinal tube of man, are introduced there by eating pork. Nor is it necessary to advert to a gratifying fact in the history of community-shakers in this country, distinguished in medical commentaries as being wholly exempt from cutaneous eruptions, scrofula, glandular enlargements, and other grave affections among pork eaters. They even forbid the keeping of swine on their lands. Throughout extensive countries in Asia and Africa where I have personally examined into the character and origin of diseases to which the inhabitants are principally incident, those of the skin and scrofula seemed quite unknown. I never saw a hog in any of my explorations in the Orient. Both Mohammedans and Jews abhor them as unclean beasts. Notwithstanding it is kept distinctly in view in this survey of the advantages and disadvantages resulting from cooking the food of animals designed for man's use, aside from being an ignoble employment for a godlike being, it is presumed there will always be occasional advocates for that unphilosophical pursuit. But the great body of intelligent farmers will not waste their labor in that way. There is no economy in cooking food for animals, as already pointed out, if time is money, under the mistaken impression that it goes further; neither is it agreeable to them to have it manipulated by cutting, chopping or bruising it between rollers. They prefer to select from the mass of hay that which a nice sense of smell instinctively determines to be proper or improper. When that which they would reject is so mixed with that which the vigilant sentinel of a special sense disapproves, and they cannot separate by the tongue, we cannot estimate the afflictions thus imposed upon them. Nature is conservative, and has made every beast the best judge of what is suitable or unsuitable to be taken into their stomach. They carry within themselves all apparatus and solvent fluids for extracting nutriment. That which is of no further use in consequence of yielding no more nutriment, is still essential, preventing the walls of absorbent surfaces from being in contract. When a volume of food that meets all the conditions for maintaining their vitality, just as they love it, is reduced in volume not to occupy the same space or furnish the required amount of distension, the animal is wronged, and deterioration follows. If persisted in, the violation of the law of their economy will certainly be discoverable. With equal propriety might children be turned out to grass after weaning, as feeding our useful animals on cooked fodder. One case is as reasonable and quite as philosophical as the other. Various experiments could be collated illustrative of the supreme folly of carrying on artificial feeding on a large scale, simply on the score of economy, every one of which have at last been abandoned; sometimes on account of the sickness of the animals, the useless expense of time, fuel, pots, pans, troughs, etc., but more generally in consequence of coming to a rational conclusion, in the attempt at saving a penny by rowing against wind and tide, to break down and nulify nature's laws, they lost a pound. Lastly, the conclusions to which we arrive in these investigations may be reduced to the following propositions, based on the immutable laws of organic life:

1. The vegetable kingdom exhibits in its varied products a reference to the maintenance of animal life of almost countless races, whose digestive powers are adequate to the conversion of such aliment into vitalized tissues.

2. Some animals are specifically organized for feeding on certain products that yield elements essential to their growth and health and no others.

3. The vast extension of grasses on all the continents and zones, speak in unmistakable language that a reference is thus shown for the maintenance of those myriads of animals that were predestined to be the food of carnivorous animals, whose internal structure could not chemically or mechanically so alter vegetable products as to sustain them.

4. Both the usages, customs and common sentiment of mankind in all ages of the world's history is this, viz.: All animals are physiologically moving within prescribed boundaries, from which they cannot be diverted, either by force or the contingencies of stern necessity, without peril.

5. Man is a being whose intellectual endowments remove him wholly and entirely above those spheres from which animals associated with him on the earth cannot be removed without doing violence to their nature.

6. The condition of animals is not physically bettered in any respect by compelling them to deviate from the dictates of their instincts. Therefore, cooking their food is a violation of an organic law. They prefer it as nature presents it, in ample abundance, in verdant fields. If driven, however, to the necessity of complying with man's behests, derangements follow, at last resulting in forms of disease nowhere recognized out of the pale of civilization among wild animals.

Persistence in feeding out cooked food to cattle or swine will, undoubtedly, produce a larger yield of lard and tallow; but all that is gained for the pocket is at the expense of the public health, since it is beyond all question, many a life has been sacrificed to an unsuspecting source (diseased meats), and those are produced by going counter to the indications of dame nature in preparing them for human food.

SLOPING HARROW-TEETH.

Mr. J. J. Thomas, Geneva, N. Y., is the first in this country who contended that a harrow-tooth ought to be small, made of steel and slope backward. He has used such a pulverizer for many years, and is now making and sending them to farmers. He wants them to try his way one season and then if they do not like it he will refund the money, and he has sent one of his harrows for the members of the Club to try. The Thomas harrow has eighty-one steel teeth, made of round steel rods, half an inch in diameter, set in oak slats two by two and one-half inches. Slanting backward at an angle of about twenty-five degrees, these slats, made in form of three gates, fastened together by hinges made of best horse-shoe iron. By this arrangement the teeth are always bright and clean, never clog, and always cut through lumps, etc., instead of pushing aside. If the harrow is used soon after planting, and as often as the weeds start until the crop is six to twelve inches high, all annual weeds will be destroyed, the great breadth of harrow enabling the farmer to go over from eighteen to twenty acres per day, breaking the crust and stirring the soil in and about the hill, the slanting teeth passing over the corn or potatoes without injury.

The harrow was referred to Messrs. John Crane, J. B. Lyman, P. T. Quinn, A. S. Fuller, P. J. Ward, Noah Parsons, and E. Williams, all of New Jersey, to give it a practical test on their farms, after which it will be tried by other members of the Club.

CORN-HUSKER.

Mr. W. H. Hoag, 59 Ann street, asked that a committee be appointed to examine and report upon a new corn-husker, which was referred to Messrs. John Crane, J. B. Lyman, and Simeon Baldwin.

Adjourned.

March 14, 1871.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Bones and Bone-grinding.

Mr. Henry Williams, Newburgh, N. Y., asked how bones are ground, and all about the process.

Mr. D. B. Bruen.—Heavy iron crushers are used, faced with steel teeth.

Dr. Isaac P. Trimble.—The machinery, if effective, is costly, and it would probably be better for the farmer to exchange his old bones for those already ground.

Mr. J. B. Lyman.—The difference would be about eight or ten dollars a ton. The Lister Brothers, in Newark, will give him twenty-eight or thirty dollars a ton for his raw bone, and sell him the crushed at about forty dollars.

There is no great difficulty in *crushing* bone. A coarse iron mill like a bark-grinder will do it; but to reduce the fragments to powder is a difficult process. If he and his neighbors have a good many tons, they should get a strong, coarse mill, and crush the bones; then reduce them to a soluble state with sulphuric acid. The true and economical way is to have in every neighborhood a bone-mill, where they are boiled and the grease saved; then assorted, and the tough white pieces, as shins, saved for buttons and brushes, and the odds and ends, and knuckles, and heads and horse bones, crushed and treated for farmers' use. England, to our shame be it said, is so much in advance of us in her estimation of the value of bone, that she sometimes orders 3,000 tons of the Listers.

Profits of Poultry Raising.

Mr. J. S. Cushing, Hyde Park, N. Y., forwarded the following statement in regard to his experience with poultry: "I feed my hens mostly with corn in winter, giving them frequently sheep's haslets, hashed after boiling, and two or three times per week a tea-spoonful of Cayenne pepper to each dozen hens, mixed with dough. They also get fresh, clean water daily. Hens want a good, warm coop, kept clean and dry. The manure they make pays for the trouble of taking care of them. In the subjoined account I give them credit for every egg laid at the price at the time, and also credit those killed at the price they would bring at the market. I think it would be well to feed one day with corn, the next with dough and Cayenne, and the next with meat and corn; sometimes with oats or buckwheat, giving them a change of food; but, not having tried it, cannot say. They are generally fed twice a day; some say keep food by them all the time. In summer, when they can get to the ground, they do not need meet. In winter they have a box of ashes supplied for them to dust in, and it is well to give them oyster-shells pounded up fine, together with their own egg-shells crushed up." Statistics were appended showing that the net returns from five hens in three years was $93.30, not to speak of eggs and chickens used in the family.

Cooking Food for Stock.

Mr. Frank D. Curtis.—In discussing the topic of cooked versus raw food, fat versus lean meat, I shall not, like my distinguished friend, visit the "Pacific slope" or take you across the Atlantic to countries where nature with lavish spontaniety supplies the wants of men, and an ever vernal climate renders those wants but few, but confine my facts and argument to our own rigorous latitude, where we have from five to six months of winter, during which more food is required for man and beast, and the latter are necessarily confined to the supplies of the stable and farm-yard. If we followed nature's laws and allowed animals to find their supply of food from nature's granary and not interpose man's behests, a derangement would follow amounting to absolute prohibition. A growth of animals and a production of animal food are important if not necessary adjuncts to our civilization. This is a problem we are called upon to work out for our own advantage, and the Creator has kindly endowed us with reason, and given us dominion in order that we may utilize these various instrumentalities to our good. There are nature's laws founded upon the physical, where the aborigine eats food prepared by nature, *raw;* and he is but little elevated above the beast which satisfies his appetite. And there are nature's laws based upon the intelligence of man, which directs him to prepare his food according to the temperature of the atmosphere he breathes, the labor he performs, and the general wants and waste of his system. I shall first consider the proposition that cooked food will produce flesh faster than when fed raw, and that the per centage of increase is so great as not only to cover the cost of labor and fuel, but to leave a considerable margin of profit; and, second, that animal food thus fed meets the requirements of the body and the brain better, and is healthier than when reason is dethroned and instinct usurps her place.

Constipation is the great curse of animals, and the cause of nearly all the diseases which afflict them. This malady prevails almost entirely during the winter months, increasing toward spring, just before the young are born, jeopardizing the life of the mother and the offspring, often causing the former to devour or neglect her young, and producing fevers, colic, casting, miscarriage, and the train of evils familiar to the stock breeder. A perpetual summer of green food, prepared by dame nature, would obviate all this; but a prolonged diet upon the dried juices and woody fibers of hay and straw and the hard unyielding cereal exhausts the gastric juice, breaks down the delicate organism of digestion, irritates the membranes, and inflames the intestines; hence emaciation or disease, and the stock come out in the spring poor. Science has made advancements in *materia medica*, and one of its golden maxims is that "an ounce of preventive is better than a pound of cure." This is just what we propose to do, to so prepare food for the animal the same as for man, which principle is illustrated at every table (of which my friend is a good example), that a hearty meal can be eaten so assimilated as to be easily digested and readily absorbed into the system without waste and without injury. Bodily strength and vigor in man are increased by the amount of food digested beyond the wear of muscle and brain, and in animals by the amount of food absorbed beyond the waste of muscle and tissue consumed in maintaining locomotion and life. When cooked, a much larger amount of food will be digested and absorbed, with a proportionate amount of growth and flesh. It is not the quantity of food taken into the stomach, but the amount absorbed by it, which benefits the system. Hogs will live on raw potatoes; but when cooked, so much more of the starch is assimilated that they will fatten. In summer swine will thrive well on grass alone. On dried grass they would starve; but I have no doubt that if clover hay was steamed and reduced to a soft pulp, approximating the condition of grass in the summer, swine could be wintered on hay alone and do well. Thorough mastication is necessary in order to fit food for the action of the gastric juices. Animals, like people, when hungry, gobble down their food without sufficient mastication. Indigestion and loss follow, for all food not properly digested is voided out and wasted unless gathered up by other animals. This is the difficulty in feeding whole or unground grain, which would be entirely obviated were they cooked. Every manure heap bears testimony to this general waste. The loss of undigested food voided in the excrement of the animals of an ordinary farm-yard would pay the cost of labor and fuel for cooking the entire supply. The only gain which the farmer has in feeding his animals other than giving milk is the growth and increase in flesh. This constitutes the profit, and is produced by such adaptation of food as to enable the animal to consume the largest possible amount without waste, which can be done far better by feeding cooked food, which will all be absorbed and be a preventive of costiveness, and in its stead producing a relaxation which is healthful. Cooking cracks the grain of starch, and renders nutritive what otherwise would be a loss. There is nutrition also in the woody fiber of dried plants, which, by steaming, are made digestible. This is proved by the fact that animal life can be sustained upon the tender twigs of trees, and browsing is a common practice to eke out a short supply of fodder. By subjecting wood itself to a high heat, a substance analogous to starch is produced, which is highly nutritious. What a saving there is, then, here for the farmer who shall steam his coarse straw and fodder, and thereby derive from them every atom of nutritive element. From forty to sixty per cent of straw is woody fibre, and when fed in a dry state is utterly indigestible, but when softened by steam, says Mr. E. W. Stewart, has a nutritive power equal to starch. Millions of dollars of food are thus annually wasted, when it might be converted into meat, milk, or wool, and goes to the manure heap in an insoluble condition, when, if steamed and fed, its value as a manure would be increased, because of its adaptation to immediate combination with the soil. Mr. George A. Moore, Buffalo, N. Y., says, by steaming, musty hay is rendered sweet and palatable, and insures a gain to the feeder of at least thirty-three per cent. Mr. Stewart found that sixteen pounds of cooked food given to a cow produced four gallons of milk per day and made eight pounds of butter per week. To make the same amount of butter required twenty-four pounds of raw food. From his experiment with milch cows, he is satisfied that cooking saves one-third of the feed.

Mr. Eastman, Dutchess county, N. Y., says that steamed food for cows in milk and for fattening animals is a great advantage. Professor Horsford says bran is greatly improved by steaming as well as other feed; he could not be deprived of it with any satisfaction. Mr. Stewart tested the healthfulness of cooked food for working horses for a number of years, and they have always been healthy except where badly used. "Cooked food will cure incipient heaves and coughs more effectually than any other remedy, and double their working ages." Hon. George Geddes, of Syracuse, N. Y., says: I find, if I take ten bushels of meal and wet it in cold water and feed twenty-five hogs with it, they eat it well; but if I take the same and cook it, it will take the same number of hogs twice as long to eat it up, and I think they fatten quite as fast in the same length of time. S. H. Clay, of Kentucky, shows that a bushel of raw corn makes six pounds of pork, while a bushel of cooked meal makes seventeen and a half pounds. James Buckingham states that three and one-half bushels of corn in the ear made nineteen pounds of pork, and one bushel of cooked meal twenty-two pounds. Thomas T. Edge found that five bushels of whole corn made forty-seven and three-quarters pounds of pork; the same amount of meal, well boiled and fed cold, made eighty-three and three-quarters pounds of pork. Ten bushels of raw corn in the ear made twenty-nine and a half pounds of pork; well boiled, sixty-four pounds of pork. An additional advantage in steaming is, that all the foul seed will be destroyed. The extra expense for cooking for forty-eight head of cattle and six horses for one season, with Mr. Stewart, was sixty dollars, with twenty dollars added for fuel, and he estimates the amount saved to be $540.

Mr. William Crozier, the well-known stock-breeder, steams the feed for 120 head of animals. His statement of cost and profit is very satisfactory. One ton of mixed feed is cooked each day at a cost for labor: One man by the month, five hours, sixty-two and a half cents, two bushels of coal, four dollars and fifty cents per ton, twenty-eight cents. Making ninety and a half cents expense. The ton of feed, before being cooked, he estimates at twelve dollars, and, when cooked, to be worth twenty-five dollars. This agrees with Mr. George Geddes, who considers the value to be doubled when food is cooked. A common cauldron kettle will hold four barrels of corn meal, weighing 800 pounds. This amount of food can be cooked on my farm at a cost for labor: One man one hour, twelve and one-half cents, and for six cord feet of fuel eighteen cents. All cooked feed should be fed when cold, and if fed in this condition will make firm, hard flesh. Mr. Crozier is selling to-day, made from his cows, which are fed exclusively on cooked feed, all his surplus butter to Mr. Lewis at ten cents above the market price on account of its superior quality. Labor for working mixed feed is the most important question, as the per centage for fuel in the country would generally be less than a fractional part of one per cent on the gain. The last authority which I shall quote showing that cooked food is an advantage, will be my learned friend Dr. Smith, who admits in his able paper read last week, that "persistence in feeding out cooked food to cattle or swine will undoubtedly produce a larger yield of lard and tallow." It is a favorite idea with the doctor "that fat meats are diseased." Can it be possible that the whole civilized world are at fault in this respect? In a climate as cold as ours a great deal of bodily heat is necessary to resist the cold, and what might be suitable food in a warmer country or in our own in summer would not be adapted to our winters. A pound of fat goes as far in heating as seven seven-tenths pounds of muscular flesh. The Esquimaux subsists alone on fat. Well developed and nutritious muscle or membrane cannot be produced without fat. A thousand pounds of the former contains seventy pounds of hydrogen, 119 pounds of oxygen, 160 pounds of nitrogen, and 549 pounds of carbon; the latter supplying the fuel for the heat required by the system, showing that the supply must be commensurate with the demand. Without fat, there would be a scarcity of heat; hence, "nature's laws" are arrayed against the theory that "fat meats are diseased." The English are proverbially a healthy people, and with John Bull the fatter his roast the better. No meats would be eatable and savory without being fat. It is the fattening process which rounds the ham of the pig, thickens the loin of the beeve, and swells the breast of the turkey. A pig without fattening would have a shriveled ham, tough and wiry, of light weight, and unfit to eat. The beef would be scanty in steaks and roasts, abounding in tendons and muscle hard to digest, with plenty of bones wanting in marrow. A turkey unfattened might make five pounds of miserable food, but when fattened there would be ten nice enough to satisfy an epicure. dame nature struggles hard in the growing season to furnish the food upon which her creatures may forage and fatten for man's comfort and enjoyment. In the spring-time the green grass tempts the appetite to renewed life and vigor; in harvest, golden heads are bowed and wait the coming of the reaper, and in autumn there is the ripened corn and the sweet aroma of fruit.

Mr. Ferdinand Lawrence.—The Second avenue railroad company of this city cooked all the food for their horses one winter, and found that the stock came out in spring twenty per cent worse off than when they fed grain raw.

Mr. F. D. Curtiss.—This is explained on the principles stated in my paper. Feeding cooked food relaxes the system, and horses attached to street cars in winter shouldn't have relaxed systems. The question, however, is not for horses attached to the Second avenue road, or any other road, but for cows and farm stock generally.

Mr. J. B. Lyman.—I cooked the corn fed to one family cow, using a kettle on the back of the stove, and found I thus saved sixteen cents a day.

Rev. Joshua Weaver.—I knew a poor man in Westchester county who steamed all the food given to his cows, and they invariably came out in spring looking much better than those of his neighbors. His were invariably free from disease, while theirs not unfrequently suffered severely. I have myself fed cooked food to poultry, corn, potatoes, etc., and never had gapes or similar disorders in my flocks. My opinion is that cooking enables a farmer to keep at least one-third more stock on the same quantity of food.

Dr. J. V. C. Smith.—The paper to which we have listened is certainly an excellent one. I have great confidence in the judgment of the gentleman who has thus favored us anew, but of course I dissent most respectfully from his conclusions, and I wish I could read another essay to confute his points, but I will not wrong you to such extent. However, I have enjoyed this discourse, wrong in theory as it is, and I hope it will be printed in the proceedings alongside of my own.

Cultivation of Orchards.

Mr. O. Snowberger, Quincy, Pa.—Men do not give their orchards much attention till they see there is something wrong, and then what they do is five years too late. Of this be sure, there must be life in the ground if you would draw life out of it. As a general rule, whatever is wanting should be supplied. Where there is an old sod around a tree, it should be reduced to manure. This can be done by digging it up or scattering ground or something else over it. Any kind of litter that is nowhere wanted — the sweepings and cleanings of the yard, the fine chips of the woodpile, the sawdust of the saw-mill, old wood about falling to pieces, old mortar, lime, ashes or anything that will have a tendency to get up an agitation of the ground, and establish a proper equilibrium between organization and disorganization. There is also to be observed the difference between positive and negative principles. Negatively, a tree cannot grow unless it stands in solid ground. Positively, it cannot be vigorous unless furnished with the proper material. Great care should be taken not to throw anything about trees that will attract dangerous animals. Hence it is best to commence with small quantities and repeat frequently.

Renewing Worn Lands.

Mr. D. C. Baker, Gettysburg, Pa.—I knew a man by the name of Vaness, who purchased a farm that had been thrown out to the commons for several years, as it was considered worthless. The first year he plowed twenty acres and sowed it to buckwheat, and when it was nicely up he sowed plaster on it, which produced a heavy growth of straw, and when it was in blossom he rolled it down and replowed it, and sowed it to winter wheat, and in the spring he seeded it with clover, which took well, and when he harvested his crop and got it thrashed, his yield was fifteen bushels per acre, and the summer following he turned the clover down when it was in full bloom, and about the twenty-fifth of August he sowed it to wheat and it came on finely, and his yield was twenty-five bushels per acre without the aid of barnyard manure, and now he has his whole farm in the highest state of cultivation, and is worth fifty dollars per acre, and when he bought it he paid but eight dollars per acre.

VENTILATING MILK.

Mr. L. B. Arnold, Ithaca, N. Y., spoke briefly, but with pertinence on the bad practice of keeping milk close covered while taking it to the factory or the town. He says while the animal warmth is escaping, it should have plenty of air; that the germs of decay are held in a putrefactive yeast, and this can be killed by oxygen. He has invented a kind of stopper that will allow the air to come to the milk, yet prevent the milk from slopping over from the tossing of a wagon. He thinks much of the mischief of floating curds and tainted cheese and bursting bandages can be forestalled by beginning betimes, and treating the milk right when it first comes from the cow.

MAPLE SAP.

Mr. L. T. Wilmot, Clarendon, Ohio, asked seven questions concerning the soil best suited to the growth of maple trees. If more sap and sweeter sap is produced from trees grown in certain soils, and if so, whether it may not be feasible to adjust matters to the advantage of the sugar-maker, and whether it is best to plug after the spigot comes away?

Mr. J. B. Lyman.—Nobody is wise enough to reply to his inquiries, and it would do little good if the answer were given; but some things about maple sap should be known and remembered about this time. Nothing can be done to a tree to sweeten the sap of it; but a maple may be made to grow more vigorously by giving the ground a top-dressing of ashes and leaf mold. In countries where there is a good deal of this crumbly granite and hornblende slate, a maple tree near an old stone wall will always prosper and grow better than one in a meadow. The crumbling of the stone feeds the roots with potash. In all such places as are very rough with this class of stones, no better use can be made of the surface than to plant it with hard maples. Every young maple that sprouts in or near a wall, should be allowed to stand and become a tree. By all means plug the bore when the spile is taken out. The bark closes over it much better. Of course tapping subtracts from the vital forces of the tree; it arrests the elements of starch, and turns them into sugar instead of woody fiber and leaf. Potash will restore much of this waste, and can be applied either in rotten leaves, as nature does, in wood ashes, or in the wash and crumble of granitic stones.

Feeding for Milk.

Mr. C. E. Thorne, Selma, Ohio, asks what is the best food, both in quantity and quality, for cows where milk is desired; also, where butter is desired? Will it pay to raise sugar beets or ruta-bagas if corn can be bought at fifty cents per bushel?

Mr. John Crane.—I have fed brewers' grains and cotton-seed meal, giving from one to four quarts at a time. This keeps the cows in good condition. I also give as much hay or other fodder as may be required. Buckwheat, ground up without removing the flour, is excellent as a milk producer. Mixed, it will pay to feed corn and roots at the price named for corn.

Mr. F. D. Curtis.—I believe William Crozier knows as much about feeding cows as any man in the State of New York, and you will, perhaps, be of that opinion when the committee appointed to visit his place make their report. He says that corn-stalks cut and steamed with roots and wheat-shorts, are the best of all food for a milch cow. Corn meal, he says, is heating. His rule is corn for hard-worked horses and for stall feeding, but oatmeal and wheat-bran cooked, with hay and roots for cows.

Adjourned.

March 21, 1871.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Cold Graperies.

Mr. Peter Sandhoral asks the following questions in relation to the cultivation of grapes under glass, which were referred to Mr. John F. Seaman, Kingsbridge, N. Y., to answer, who sends us the following communication:

I propose answering his inquiries as far as I am able.

First. He says his house is twenty-six by fourteen feet, but does not say whether it is a hot or cold grapery, nor whether it is a lean-to or a double pitch-roof. Had he mentioned these, it would have saved some unnecessary explanations.

Second. He enumerates eight vines of different varieties, and states "he has room for more."

Third. He asks, "What is the proper time to start them !"

Fourth. "What temperature to keep the grapes ?"

Fifth. "What kind to get to fill up, that will be most profitable to sell, as he wishes to raise for market."

Sixth. He asks for any other information on the subject, as he says he is a new beginner, etc.

Answer. Supposing his house to be a hot-grapery, he may start his vines when he likes. If coal is cheap, and he don't mind getting out of bed at midnight to look after his fire, he may start them in November, and from that till the first of February, or later, if he likes. If he is successful with winter-started vines, he may, if he has luck, sell the fruit for five dollars per pound; but it will cost him more than that, particularly if there is a coal-strike. The best for him is the month of February; but, when once the heat is up, it must be kept so, or, rather, increased by one-half to one degree daily, if he can do it, which is very questionable. It must not go down after the buds start.

If a cold-grapery, the longer he can keep the buds back the better, as, after they have leaved out, a frosty night will destroy his fruit for the season; but, if he can be sure that no frost will enter his house, he may start them when he likes. He must, however, look out for the cold nights. I think, if he is a "young beginner," he had better not be too hasty in starting them. "The more haste the less speed," would very well apply here.

Second. He enumerates eight varieties of grapes, consequently has eight vines. This is all his house will properly contain, consequently requires no more. This will leave three feet, three inches between the vines, which is near enough, in short, too near. In my house the distance apart is three feet six inches; had I to do it again, I would allow four feet between them, which would be better. If his house is a lean-to he can put temporarily eight more on the back wall, but his fruit (owing to the shade of the front vines that will cover the top of the house) will amount to but little; the same will apply to the rear side of a double pitch, but not in the same proportion; eight vines will cover his house. If however, he wants nine, let him get Black Hamburg, which are the best variety; or if he wants large bunches, let him get the Syrian or White Nice, the latter of which can be grown that one bunch will weigh sixteen pounds, but the flavor is poor.

Third and fourth. The reply to these has been heretofore given.

Fifth. What kind to get to fill up? Answer above; as he wants to raise them for market.

Now if he undertakes to raise grapes in a house fourteen by twenty-six feet, for market, at a profit, he will be sadly mistaken in the result. His house will not produce under the best management more than is required for his family and scant at that, should he have a large family of small children. In short, the gross sales of his entire house, even if sold at the highest market price, would not pay one-half the wages of his gardener. Let us look at it squarely as it is: He has eight vines, house fourteen feet deep, vines will cover but sixteen feet in length, when his house is in full bearing. We will allow a bunch of grapes to each six inches of vine (a very liberal allowance). Allow the bunches to be *all* fine ones, to average one pound each. The result is thirty-two pounds to a small vine (*a tremendous crop*). His house would then produce 256 pounds, which we will allow, although it is about double that he will obtain from it. Now he may sell these grapes (if he has luck) for one dollar per pound; this will produce him $256. Now he cannot get a gardener competent to take charge of a vinery under fifty dollars per month, and also to find him a cottage, his fuel, milk, vegetables, etc., in addition, which will amount to twenty-five dollars per month additional. Admit that the gardener will spend but one-third of his time in attending to the vinery (he will, in fact, spend one-half, particularly in winter), his expenses for this one-third would be $250; this would leave six dollars as profit, taking the best views of everything; but to satisfy him, we will carry the account further, and see what profit he can realize. Say

Gardener's wages and expenses	$250 00
Manure for top-dressing, say	10 00
Glazing, painting, repairs, etc	20 00
Tools spoiled, broken, rusted out, lost, etc.	10 00
	$290 00

The above is a *low* estimate of expenses; he will find he exceeds it in every item. A vinery is a fancy article, like a canary bird, a parrot or a dog; they serve as amusement but may be made profitable; but should not be less than 400 or 500 feet long. It must also be a hot-house, and he who attends to it should devote his whole time to it; he may then make some money. But your correspondent can do better by raising pickels for the market than grapes, in this (his) house. I may here say, or he may say, I have taken no account of the crop on the rear wall. Answer: As they amount to nothing, they are not worth speaking of.

He finally asks for any further information respecting the culture of grapes. Here is a large margin; I will briefly consolidate some slight information that may be of practical use to him. All gardeners, however, know about it, or at least they ought to. First, then, when the buds or eyes start, there will generally (if the borders be good) start two side shoots from each eye or bud; when they have progressed a little, rub off the weaker one, allowing but one shoot from each bud. When these side branches are six or eight inches long, or perhaps before, they will show buds; now tie these branches to the wires. There will generally (under proper culture) be from two to three flower buds from each side branch. When they shall have attained a size so he can see which is the best, cut off all but one to a branch, leaving but one bunch to each branch. He will get more pounds of grapes in this way, and much finer bunches, than by leaving more to ripen.

Next comes what gardeners term summer pruning; they say, and generally agree to cut off the side branches at two or three leaves from the fruit, as they elongate, and afterward cut again at one or two leaves from their first cut. They say this is better for both the vine and fruit, and it should always be done. In this, however, they labor under a great mistake; with as much truth they might say it was better for a man's brain to cut off his head. In many instances it might be so, and doubtless is particularly so if they try it on themselves. They then would not be guilty of propagating such absurd doctrines. But in a grapery, with vines so closely planted, it becomes a *necessity* to cut the side branches back to allow the free action of the sun to ripen both fruit and vine, but it is *not an advantage.* Give the vines sufficient space to grow their whole length and you will have finer and better fruit, and heavier bunches. I have fairly tried it, and I know this to be so. However, your correspondent has not the space for experiments. He is, therefore, necessitated to follow the common mode; that is, not to let the side branches pass those of the adjoining vine, or, in short, not to crowd their neighbors as they do in street railroad cars. He must not, however, cut or shorten the leading branch. Enough on this point.

When the fruit gets the size of very small peas, he must go over the bunches with a sharp pointed scissors and cut out the smaller grapes, the center ones particularly; he will cut off now about one-third of the bunch. It is called thinning them. Again when they grow about as large as Colt's pistol shot he must again go over them and a second time thin them out. This is the most troublesome thing in grape culture; in short, the only thing troublesome about it; it is a hot tedious job, but he need not mind thinning out eight vines.

Now by keeping the border well watered with tepid water, occasionally stirring the soil to keep it loose, destroying the weeds, throwing water over the leaves, tying up the branches when required, keeping off insects and mildew, ventilating when necessary, but *always at the top* during the progress of vine and ripening of the fruit by constant care, generally he will have as good fruit as his neighbors. In conclusion, I would suggest that he purchase "The American Grape Grower's Guide," written by William Chorlton. By studying this carefully, he will get more information than I could communicate him in a month.

METEOROLOGY.

The Secretary presented the following communication from the Hon. Horace Capron, of the Department of Agriculture, Washington, D. C.:

I beg leave to acknowledge the receipt of a report of a committee of the American Institute Farmers' Club, on a communication from Professor Andre Poey on the subject of meteorology, in which this department is recommended to communicate the plans of Prof. Poey to the presidents of agricultural colleges, and urge the adoption of some such plan of observation as therein recommended. I have always looked upon the relations of meteorology and practical agriculture as necessarily very close, and that by just so much as our knowledge of that science is increased shall we be likely to have more certain and abundant harvests, and I, therefore, think that a more extended network of observation in the several States than that carried out by the secretary of war, for the benefit of commerce is desirable for agriculture, and that these should be subordinated to a central office or bureau in order to make them uniform and utilizable. I have only partially succeeded in impressing this view upon Congress.

I have no control over the various colleges alluded to, and the adoption of this plan would involve some additional expense in each institution, and, therefore, I am unwilling to assume the position of adviser, although I am of the decided opinion that the pursuit of such inquiries is a part of the plan of improvement in agriculture which it was contemplated these institutions might effect.

Apple Trees Girdled by Mice.

Mr. Andrew Sherwood, Mansfield, Pa., wrote that he was troubled by mice girdling his apple trees.

The Chairman.—I saw some trees at P. T. Quinn's that had been saved by ingeniously connecting the bark above with that below by grafts.

Mr. A. S. Fuller.—Sections of bark may be taken from other trees and grafted on the gnawed ring.

Mr. C. D. Bragdon.—Every agricultural and horticultural paper in the country has published full directions about this matter. If people will remember what they read there will be no trouble.

Mr. A. C. Briggs.—It was stated recently before a western horticultural society that a gentleman had 100 pear trees, seven years planted, entirely girdled by mice, many of them for a foot up and down, and even, in some instances, the sap-wood was gnawed half an inch deep. As soon as the damage was discovered, which was during the first thawing days, he banked them with snow, and when the frost was out of the ground he piled soil a foot high around the trunks. They received no further attention, but in time the damaged parts were covered by a thick coating of new bark. When the girdling is high up, which don't so often happen, banking becomes impracticable, and clay may be bound on with a bandage. It is important that this be done as soon as possible, as the death of the tree is caused by the seasoning of the sap-wood.

Mr. F. D. Curtis.—I do not believe that any tree from which the bark has been gnawed all round can be permanently saved by any such process, though it may live through the year. There is a possibility in the hands of a skillful manipulator of prolonging the life of a tree thus injured by cutting a scion long enough to connect the bark below the wound with that above, as the Chairman describes. But even this is a delicate operation, and scarcely ever succeeds. The better way is to dig the tree up and set another in its place, or, if not too large, the stock may be grafted, or, if let alone, sprouts will come up, the most promising one of which may make a tree in due time. Far wiser, however, would it be to prevent these catastrophes by proper precaution, such as treading down the snow after each storm, or, what is better, piling manure around the trunk in the fall. The latter plan serves a double purpose, for, beside protecting from mice, it enriches the ground. In the absence of manure, use earth.

EXPERIENCE OF AN OLD FARMER.

Mr. Alfred Curtis, McKean, Penn.—Forty-six years ago I came to this county from Washington county, Va., with a yoke of oxen, wagon, wife and two small children. Twenty dollars, besides, would cover all my capital. I turned out my oxen and wagon for $120 toward paying for my first fifty acres, for which I had to pay four dollars per acre; the balance I paid in days' work at fifty cents per day. I added to it until I had $200, and I have sold and given away all but nine acres, where my good wife and I can sit under the shade of our own maple trees and count up forty-six children and grandchildren, all brought up to industry and self-reliance. Now, as the time is drawing near for the setting of maple trees, I will give my experience. About seventeen years ago I set a hundred trees, from which sugar has been made for the last two years. The last three years I have set 170. If I set in the spring I wait till the sap has done running. Then I go to the woods with a nine foot pole, an old ax, and grubbing hoe. I take trees about three inches in diameter, cut around about ten inches from the body, and in most cases we can turn out by the roots, cut all off above nine feet; often there is not a limb left. Then we endeavor to set them about the same depth as they were before, for which we want a hole about fifteen inches deep. Set in the tree, filling in all the finest mold. Then we pour in two pails of water. Trees thus planted I have not lost more than one in twenty-five. One man has dug, hauled and set thirty in a day. I set my last trees twelve feet apart. On wet land I set on the top and bank around. As yet all have done well. In a late report I saw an article on corn destruction by worms. My way is this: I put from five to eight kernels in the hill, make a heavy spat with the hoe, then put one part hen droppings, one of plaster made fine; then I put about a gill on a hill; the first rain comes soaks it down among the corn, and I think the worms don't like such food. In forty years I have never failed in corn, while I have seen fields around me destroyed by worms. May the Club and all connected with it long live to scatter light on this dark world on the subject of farming. Times are very different now from what they were when I began in the woods. I have hauled forty bushels of oats ten miles to pay for one barrel of salt, and we have hauled our corn in the stalk ten miles through the woods to make cakes for the children. I am now in my seventy-second year; never went to school to be taught my letters; did not know all of them till after I was married.

REPORT ON MR. WILLIAM CROZIER'S BEACON FARM.

Mr. F. D. Curtis made the following report: Your committee were requested to visit the Beacon stock farm at Northport, R. I., and report especially on the new piggeries built by the manager, and look into his plans and practices in swine breeding. We find we cannot do justice to William Crozier nor convey the lesson we would to the farmers of this country within the margin of a commission so narrow. We will speak of the hog pens at Beacon farm, and of much beside. Your committee have enjoyed some opportunities for comparison and close observing of farmers in America, their merits and their shortcomings, the excellence that many of them aspire to and some of them attain; and we are not without national pride and the conviction that American spirit and invention and daring are equal to anything; but we must say that this weather-beaten, canny Scotchman, William Crozier, might take the ablest and oldest of American farmers over his yards and fields and astonish them by a revelation of their own ignorance and incapacity. We know of no tiller of the soil that can present so brilliant a record of great things accomplished, great strides along the path of improvement, solid results won by solid industry, as the history of the changes at Beacon farm during the two years since Mr. Crozier took the control. In 1868 there were on the place six or eight cows, a pair of mules, a horse or two, and 300 head of Merino sheep. They made about seventy-five loads of manure. The 600 acres of arable land was cut in twenty or more small fields, divided from each other by old hedge rows full of briers and small cedars. Several hundred acres were in an old common that yielded scant pasture for two or three months in summer. Much of this common was overgrown with oak bushes, little cedars and hickory stunts. Now we find the farm stocked with eighty-two horned cattle of superior thorough-bred stock, fifty-two horses, twenty-seven sheep, seventy-five hogs, 300 hens and thirty-five ducks, and he buys no hay, no corn or oats, no roots. He has fifty acres in one clover field. The sole outlay for cattle food is about $500 for wheat shorts. Instead of seventy-five loads of manure we estimate his compost piles for use this spring and summer to contain 6,000 loads. Manure making with this vigorous farmer is not a theory, an effort and a wish merely, as it is with thousands. He makes it. There are the immense banks of it standing a fathom deep in the main stock-yard, and looming above the furrows of all the plowed fields. His compost pile is not the winter's accumulations thrown into the yard from stable doors and windows to be hauled in the field in April and May. Manure making, composting goes on the year round; no day of winter so frozen but it sees additions to the piles of fertilizers; no summer morning without its rounds of chores that swell the heap. "Everything," he says, "must have a mother, and manure is the mother of all things." He keeps an ox-team, and has them driven steadily at work the year round, hauling absorbents and composting stuff. His task is five loads before dinner and five after dinner of leaves from the woodlands, muck, weeds, and salt mud. His calculation is that the solid droppings of a cow or ox amount to something like ten loads in a year, and that ten loads of muck and leaves should be composted with it. For manure-making, he says four sheep equal a cow, a horse equals two cows, and two hogs equal a cow. Pasture land he does not believe in. Young animals and milch cows should have a small range and run it an hour or two for exercise. But a quarter of a mile a day is all the walk a milch cow needs. This forcing a cow to range over a wide reach of hill and swamp and moor and wood for the material to make milk of, is, he insists, the crying sin of American dairymen. He is a thorough believer in cooking for all farm animals in winter, and cutting green food for them all summer. Beginning, for instance, with May, he goes through the year as follows: May, old hay, the last of the stalks and roots and rye; June, clover and oats; July, sowed corn and fresh meadow hay; August, sowed corn, clover and oats; September, sowed corn, field corn, soft heads of cabbages; October and November, turnip tops, corn, beet tops, carrot tops and roots; November fifteen to May fifteen, boiled food, corn-stalks, hay and roots, steamed together and sprinkled with meal and shorts, the rate being about four tons of roots to one of stalks and hay. He used Prindle's boiler, large size, and a double steam-box. The stalks and roots are all cut fine, shoveled into the box, and the steam let on. In about six hours it is soft, so that a stick can be pushed through it. It is allowed to cool to the temperature of the blood before it is given to the animals. His roots, Swedes, mangels and carrots are grown in the following manner: Draw furrows say two and a half feet apart, and fill them with manure; then cover with a double furrow and roll flat, and open enough to receive the seed; cultivate with horse-hoe. On land not remarkably fertile, he gets thirty-five tons to the acre; allowing thirty bushels to the ton, that crop is 1,000 bushels. He harvests by plowing them out, first clipping the tops while in the ground with a sharp steel hoe; then he harrows over the field, lifting the teeth as the roots become entangled. Then dump-carts go on, and gather and throw them into long piles by the road. These piles are covered with tops, straw and earth and loads are taken out daily as they are needed at the barn. With 6,000 loads of manure he has enough to dress thirty acres very heavily, and all his Swedes were large, as also his carrots, many of them, taking from any part of the pile, measuring three inches across the crown. He cut sixty tons of hay, and we saw at least twenty yet in the barns (middle of March), for his dependence is upon roots. He had thirty-two acres in roots in 1870, and estimates his crop at 30,000 bushels. Beside these crops he has made extensive and permanent ameliorations. Bushes have been grubbed up, fences rebuilt on all parts of the place, tough old pastures thoroughly plowed, the forests trimmed and raked, young groves of locusts nursed, gates hung, high yard fences built, and roads graded. He has the best milk-house we have ever seen, not excepting the famous dairies of Delaware county, west of Philadelphia. His hog-pens are commenced on an excellent model, but to describe all these and his system in connection with them, would be to write a treatise on butter and pork-making. We submit this as a report of progress, and have given the chief features of his faith as an agricultural thinker, and his practice as a successful farmer. Nor have we said these emphatic things from a wish to praise Mr. Crozier, but simply to let farmers know how striking the real successes of their profession are.

J. B. LYMAN,
FRANK D. CURTIS,
Committee.

NEW JERSEY STEER.

Mr. B. M. Polhemus, Somerville, N. J.—A good steer was raised and fed by Mr. Henry Peters near this place, and sold, standing, for $250 to Mr. James Smith, who slaughtered him in December last for retail at Somerville. Gross weight, 2,212 pounds; net, 1,370 pounds of beef; hide, 140 pounds; making sixty-two pounds of beef per hundred live weight. The above steer, when slaughtered, was four years and six months old, was fed no grain worth naming until March, 1869, commencing at one quart per day, averaging four quarts per day for the first four months, six quarts for the next four months, eight quarts for six months, and averaging twelve quarts per day for the last seven months; was a grade steer, half blood, Devon and Short-horn.

PAINTS FOR TIN ROOFS.

Mr. F. J. Davis, Dryden, N. Y., said: "We want a paint for tin roofs that will last, and cheap, too, if possible. We burn coal and our tin roofs rust before they have been on six months."

The Chairman.—I have used Prince's metallic paint.

Mr. A. S. Fuller.—There are other metallic paints just as good, which I use.

Prof. H. E. Colton.—The best paint for any kind of metal roof is zinc-lead, next brown zinc. Brown zinc is a mixture of oxyd of iron and zinc. The various oxyds of iron, as Grafton, Richmond, Lawrence's, Prince's and other metallic paints, are next best, and somewhat cheaper. Yet the best is often the cheapest in the end, and as in warm weather a white roof is much preferable, we can recommend, first, the sinc-lead. We have seen roofs painted with it that have lasted better than any other substance. The farmer can get any of these paints at his country store; the various ochres are all oxyds of iron. In making a white roof, white lead should never be used, as the atmosphere acts on it very rapidily; and, further, if you wish to save the water running off the roof it will be poisoned. In the country a farmer has only to go to his drug or paint store, buy his metallic paint; they are generally sold dry, not in oil; mix one-third boiled oil, two-thirds raw linseed oil, and go to work.

CANKER WORMS.

Mr. J. Tracy, Bloomington, Wis., wrote to know how to get rid of canker worms. Dr. Trimble gave a learned and interesting oration upon the worms, but seemed to know of no remedy but the dear little birds.

Mr. S. Baldwin.—The authorities in New Haven prevent their trees from being destroyed by putting around the trunk a cup-shaped band of zinc or lead, and, filling it with fish oil, they are never troubled by the canker worm.

Adjourned.

March 28, 1871.

NATHAN C. ELY, Esq., in the chair; JOHN W. CHAMBERS, Secretary.

CHESHIRE AND JEFFERSON BREEDS OF HOGS.

Mr. T. B. Stanley, Cambridge, Mass., wrote: "Sometimes I see the hogs bred in Jefferson county, N. Y., called the Cheshire, and sometimes the Jefferson county breed. I should like to know which is correct, and if there were ever any hogs imported into this country from Cheshire, England. I should like to know something about the red hogs of New Jersey."

Mr. F. D. Curtis.—There is a family of hogs in Jefferson county, N. Y., which have been bred but long enough to be called a breed, which was established by crossing the Yorkshire with the native breed, and subsequently with hogs imported from Canada. They are a good breed of white hogs, and are called Cheshire by a number of the breeders of them. This might be very proper as a fanciful name, but when the pretension is coupled with it that they are Cheshire, and descended from hogs imported from Cheshire, England, then the name is very improper. It would be better to call them Jefferson county, and be truthful and consistent, and follow the example of Chester county, Pa., as they have done there with their pigs, the Chester county whites. I do not believe any connection can be shown between the so-called Cheshires and any hog in Cheshire, England. The breeders of Jefferson county have done a good thing, and they need not be ashamed to give their county the credit of it. The sandy hogs of Jersey have been bred in that State for upward of fifty years. They are a large, coarse breed, and make heavy hogs. I have met them in other places, with different names, which are provincial. In Saratoga county, N. Y., they are known as the Duroc. I have always supposed that they originated by crossing the old Berkshires with white hogs, resulting in a sandy. This may not be so, and if it is not I should be glad to know where they did originate.

RAISING OF POULTRY.

Mr. H. H. Stoddard, Hartford, Conn.—The report of a visit to Warren Leland's states that the Club and farm journals have heretofore wrongly concluded that poultry-keeping on a large scale is impracticable. I would communicate my experience bearing on the question. Ordinarily it will not pay to raise fowls in great numbers for their flesh. Very early chickens may be sold in limited numbers at prices ranging from one dollar and fifty cents to two dollars and fifty cents per pair, and afford high profits. But broilers at such rates cannot be considered a staple article of produce, as only the rich buy them. Later in the season, chickens bring but little more than the cost of the food they have consumed, as any one may prove by keeping accounts. Chickens kept till eight to ten months old will hardly bring enough to pay for their feed. A man may spend a summer in raising a number of thousands of chickens, and not realize seventy-five cents a day for his labor, provided he buys all they consume at regular prices. Mr. Warren Leland grows poultry meat by the ton, mainly on scraps of bread and other hotel waste. He does not keep close account of his fowls; but if the bread, etc., was appraised at the value of its equivalent in grain, there could be no considerable margin of profit. If such crops can take the place of grain, then they must eventually have a recognized price, just as much as brewers' grain or chandlers' greaves, and must be accounted for accordingly, while we are estimating the merits of poultry raising as a business. The wintering of a few hundred fowls, and rearing from them as many thousand chickens annually, is not a very difficult problem, though it needs rather more skill and care than the ordinary branches of farming, and a peculiar tact and patience. But if, as I have claimed above, it cannot be done with profit, the matter is of little practical interest to farmers. It may be asked, why so many raise chickens to sell for their flesh, if there is no profit in it, for millions are produced for market every summer, a few from each farm. I answer, that it is to be expected, for various reasons, that every farmer will have a few hens. They afford his family an agreeable change of diet, give his children their first lesson in industry, and are an ornament to the farm-yard. What would a farm be without the music of cackling hens and crowing cocks? The supernumerary chickens and fowls past their prime make a vast aggregate, which would be thrown upon the market annually, whether they cost more than they come to or not, Then, no doubt, as a matter of fact, the fifty or 100 chickens sold every year from the farm do bring more than the value of the grain consumed; for, when a few only are kept, they subsist, in good part, on what they glean, which costs nothing. But when it is attempted to keep chickens by the thousand, a few odd grains from the barn-floor and insects from the orchard will go but little way.

The poultry-meat—in such case tons in weight—must be mostly grown from grain, a cash article. My experiments, carefully conducted for a number of years, with rigid accounts kept from first to last, have proved to my satisfaction that, though it is easy enough for one who understands it to rear great numbers of chickens, it cannot be done with profit. If any one doubts, let him try it and keep accurate accounts. Let it be noted that I do not deny that a few persons may, by extra accommodations, anticipate their neighbors by a few weeks, and make money on very early chickens; but such a basis is too narrow for the multitude to do business upon. A few others find profit by selling live fowls of fancy breeds at high prices; but only a few can do that either, the demand being limited. As for feeding upon hotel-waste, which costs nothing, undoubtedly that pays; but what most of us want to know is, whether it will pay if we have no hotel of our own and have to depend upon grain. There has been in almost every county of New England some one who has tried the experiment of poultry on a large scale and abandoned it. Now, I am as thoroughly convinced that keeping poultry for their eggs may be profitable, as I am that raising chickens in large numbers for the sake of their flesh must be unprofitable. While the *modus operandi* of chicken-raising on a large scale has been exhibited by Mr. Leland and others, no large egg manufactory was ever successfully run, so far as I know, in this or other countries. To keep a great number of laying fowls the year through in health and productiveness both, is vastly more difficult than to raise chickens by the thousand. Using proper care to secure sanitary conditions, great numbers of laying hens may be kept with little or no disease, as unquestionably as that great numbers of convicts may be confined in our prisons with less disease than in an average outside scattered community. But prolificness is a different matter from health. Frequently animals of some species are kept for many years in vigorous health without any reproduction at all. Darwin says that the elephant, however perfect in health, and kept in its native climate, and allowed its natural diet, and as much freedom as our cattle have in their pastures, plenty of exercise, pure air, and everything that can be devised, will not breed at all in the tamed state. Now hens in small flocks will lay well if well treated, and of good breed and not too old; but kept in *large* flocks, it is a different matter. If the Club can solve the question of keeping hens in large numbers upon one farm, and securing the full yield of eggs (say 100 to 125 per hen each year), under a system of management that shall produce profit, they will have achieved a feat never yet published. This is a day of specializations of many branches of rural industry; the advantages of division of labor belong to farming as to other employments. Accordingly we see milk farms, small fruit farms, others devoted chiefly to sheep or horses, butter factories, market gardens, and so on, but the egg farms are nowhere, though many persons have tried to raise eggs by wholesale. The matter seems to be as much a poser in farming as perpetual motion in mechanics, or squaring the circle in mathematics.

Mr. Ferdinand Lawrence.—Some thirty years ago I was in London, and was invited to visit a gentleman who had made a fortune in the poultry business, and was about to quit it. We sat down to a dinner of which all the meat was poultry. Our host made a speech, in which he told us that he had been forty years in the poultry business, and had made a large fortune. He said that he never kept more than 1,500 fowls, and seldom less than 1,000. This, I think, shows that there is money in the business.

Mr. A. S. Fuller.—No one doubts that some few people, close to cities, have made money out of poultry, but mostly by raising fancy fowls. I never knew a man who made money by it alone. South, where land is cheap, a person keeping several hundred hens on a farm can make money.

Prof. H. E. Colton.—I agree with the gentleman, that near New York raising chickens may not be very profitable, but I know that friends of mine at the south have made and are making money raising chickens and eggs. They are sent by rail or steamer to Washington, Baltimore, Philadelphia and New York. Freights for all such articles are very cheap. Land is low-priced there, and they can afford the acres for them to roam over. I do not, however, know any one who is doing that alone as a business, but they connect it with farming varied crops.

How to Grow Asparagus.

Mr. D. B. Bruen read the following paper: There is, perhaps, no succulent vegetable more generally valued for its palatable, nutritious and healthful qualities than asparagus, and it can be successfully cultivated in any climate, from the tropics to the cold, bleak shores of Lake Superior, where it is found growing in its wild state. Asparagus is also found in its uncultivated state in low and often flooded fresh and salt meadows, as well as in the barren salt sands on the sea-shore, where the spray from the breaking wave would reach the plant. Its proper mode of cultivation seems, from its results, to be less understood than any other vegetable produced for table use. My first knowledge of asparagus (when a boy), some sixty years ago or more, was an old bed in my father's garden, which was put out by my grandfather before my father's recollection. That bed was cultivated on the same spot of ground until about 1810, when it became necessary to use the ground for building purposes. The old asparagus roots were carefully removed and put out again, where they remained until 1852, when the bed was destroyed for the purpose of erecting a building on the grounds. From the time of the removal of the roots until they were destroyed forty-two years had elapsed, and from the time of the first planting of the roots by my grandfather until they were destroyed was at least 100 years. The bed was always well cultivated. (The old stalks were closely cut off in the fall; the bed was literally covered with manure which was forked in, in the spring.) Until its destruction, the asparagus never decreased in quality or quantity. These facts of my own knowledge are satisfactory to my mind that the limited production and failure of new buds is from a neglect of its proper cultivation and the want of vitality in the roots used. There are a great variety of opinions in relation to the correct mode of propagating and cultivating asparagus. Some writers say that the earth should be removed three feet deep, or more, and the bottom filled with stones, shells, and old boots and shoes, to prevent the roots running down, and the earth removed should be mixed with manure and returned, and that the roots should be set eighteen inches or two feet apart and be planted twelve inches deep; others say that six to fifteen inches apart and four to twelve inches deep; and recently, before this Club, four feet apart. With such badly balanced opinions among so many theorists no definite mode of cultivation could be arrived at. Some twelve or fourteen years ago I laid out an entirely new garden where I now live, and having always enjoyed the luxury of asparagus without depending upon the market for a supply, I made a bed to suit my own views of the nature of the plant. My soil is a heavy sandy loam. I prepared my ground with a large quantity of well-rotted manure, and divided my ground into beds five feet wide and eighteen feet long. The ground was then dug up one spit deep, the length of a long spade blade. Believing that asparagus, like all other vegetation, required the warmth of the sun and air to reach the roots and surface moisture from dew and rain, and having no fear that the roots would run down beyond my control, I placed all the roots four inches deep and twelve inches apart. The roots were two years old, and were taken from a garden adjoining my own. As soon as dug from the ground they were placed in the trenches, each branch of the roots was spread out as it grew naturally, and the crowns were covered four inches deep. The asparagus grew apparently as well as though the roots had never been removed. The next season I cut from the bed a sufficient quantity to supply my own table. Every season when the weeds commence growing, I sow broadcast one-half bushel of salt, and the same quantity twice afterward as the weeds begin growing again. I always have asparagus before any appears in market from the market-gardens in the neighborhood, and I cut it every day from the time I commence until the season ends. The productiveness of my bed has increased, and all gardeners and others who have seen it pronounce it the most prolific bed they have ever seen. The average growth of the stalks, at the time of seeding, is from five to eight feet in height.

There is no one article cultivated by the market gardener that will pay him so much for his labor as asparagus. But the great failure of many market gardeners, as well as in private gardens, with asparagus, is the careless and improper manner in which they make their beds and place their roots. They should always grow their own roots, and never take them from the ground until their bed is ready to receive them. When the ground is dug up it should be thickly covered with well-rotted cow-yard manure, and made as rich and mellow as a hot-bed, and laid out in beds five feet wide, with walks between, two feet wide, to prevent treading on the bed. A trench should then be dug six inches from the edge of the bed, deep and wide enough to place the roots four inches deep and twelve inches apart, with the roots spread out with the hands as they grow naturally, and the rich earth and manure worked among them with the hands. When the trench is filled lay boards over it to prevent treading on the earth crossing the trench. Dig out the trench, and place roots as before, twelve inches apart and four inches deep, and so on alternately until four rows are planted. Then make a path two feet wide, beginning six inches from the last row planted, and so on alternately with each bed. My beds have been planted some thirteen or fourteen years, and but in three or four instances have the crowns spread in the two-foot walk six inches from the center of the crown root. Hence the fallacy of planting the roots several feet apart, to give room for the crown to spread to fill up the vacant space. Some gardeners place their roots ten to twelve inches below the surface. The consequence is that when the sprout has reached the surface it has already grown enough to be cut and when it has grown two or three inches above the ground, it is cut some eight or ten inches below the surface, and nearly the whole length of the sprout is white and tough, and no more fit to be eaten than a soft green stick, and two or three inches of the head ready to expand itself into its lateral branches, and with but little of the marrowy taste and flavor of sprouts produced from roots planted four inches deep. Beds should never be trod upon. Roots four inches deep is enough to fork up and work in the manure, which has been their winter covering, and will produce stalks soft and marrowy when grown six inches above the ground and cut one inch below the surface.

Mr. Mapes says, in his Working Farmer, that there are twenty-eight species of asparagus. Some writers have attempted to classify the different qualities, and give them some Latin names. With my experience in raising and largely consuming the article, I think that I could quite as easily distinguish between the taste of a white hen's egg and that of a black one as I could tell the difference in the quality or taste of the purple or blue-headed asparagus from that of any other color or species of the plant. The profits of cultivating an acre of asparagus properly put out and well attended to, and doing everything at a proper time, will better pay for the amount of labor necessary than any other one article that can be produced in a market garden. It would require a great deal of labor to put an acre of ground in asparagus. After it began to be productive the labor necessary would be to fork it up in the spring, cut and market it. It would require close attention until the end of the season (say the middle of July). It would not be necessary to give it any more attention but to salt it until November, when all the stalks should be closely cut off with a knife, and the bed covered liberally with well rotted manure. From the quantity produced from my bed, eighteen feet by thirty-six feet, I think that one acre of asparagus, properly cultivated, would produce more dollars, with less labor than any other horticultural production. The slovenly manner of cultivating and taking care of asparagus beds can be seen in every market gardener's grounds, as well as in private gardens, and gives the whole solution of the want of success in its cultivation. To produce good healthy roots, prepare the ground with well-rotted manure, spade or fork up one spit deep, remove the earth from the drill three or four inches wide and three inches deep, sow the seed not to grow closer than three or four inches, cover with the earth removed from the drill half inch deep, water the rows if dry weather. When the seed has a vigorous growth, draw some of the earth that has been removed from the drill alongside of the plant; next row two feet to give room to work between rows, and so alternately with each row. In the fall, cover the plants with the earth that has been removed from the drills, and cover the whole with manure. Leave the roots to grow until two years old; they will then be strong and vigorous to remove. The next year, after the new bed is made, the sprouts can be cut for the table, but be always careful not to tread on the bed or lay any heavy weight on it. Pack the earth; then your bed will always remain mellow, with forking-up in the spring to work in the manure with which the bed has been covered through the winter.

Dr. Isaac P. Trimble.—Mr. Bruen has a right to speak about asparagus. I have seen how it grows in his garden. Asparagus is not the best vegetable, but it certainly is the best in its season; but the supply in this city is almost worthless from the present fashion of cultivation and cutting. Look at the bunches in the market, six, eight, or ten inches long, and three-fourths of that length perfectly white because grown under ground. When it comes to the table only one-fourth is edible, all the rest tough as leather; in fact, a mere prolongation of the asparagus root. I was in a large asparagus field in Monmouth county, N. J., last week, where they were busy at work. A heavy coating of manure was placed along the rows, and then a deep furrow turned upon it from each side, making high ridges. The field was perfectly corduroyed. I asked the owner if such deep covering was right. "Oh, no," was his reply, "it is all wrong, but properly cultivated asparagus would not sell in New York, and we cannot change fashion. I would have but two or three inches of covering, and then cut just under the surface. In other words, level culture. If this Club has influence to change this stupid fashion it will certainly do good." What other vegetables do we buy, where three-fourths we pay for are perfectly useless? It is the top and not the root of asparagus that is edible.

THE LUPINE AS A FERTILIZER.

Some weeks since some mention was made in one of the reports of the lupine and its value for fertilizing light and exhausted soils; since which the Secretary has received an immense number of letters asking for further information, and whether the seeds can be procured in this country. Hence he prepared the following in the way of reply: Ten years ago the subject was written upon by the various agricultural journals, and several elaborate articles were furnished by gentlemen and disseminated throughout the country. In the agricultural report of the Patent Office for 1861, page 370 to 373, Mr. Louis Schade has a valuable essay on the character, cultivation and use of the lupine. He says: During my visit to Europe, particularly in Prussia, the latter part of the summer of 1861, my attention was called to the cultivation of this plant, which had made quite a sensation in agricultural affairs in that part of the world. This plant is the lupine, known in this country as a garden flower. From trials made during the last ten years in northern Germany it was shown that it not only makes excellent fodder for cattle, especially for sheep, but that it also had the most astonishing fertilizing power, if used as green manure. It will grow on the poorest soil unassumingly and without pretensions to laborious cultivation. Large estates, which on account of light, sandy or exhausted soils were almost worthless, are now by the cultivation of the lupine producing in value as much as those of the best soil. Where formerly, from want of meadows, a hundred sheep were kept, a thousand will now get through the winter without trouble by using the lupine as fodder. Mr. Schade says that it is remarkable that the lupine, with all the benefits it bestows, should have been forgotten for centuries. The ancient Romans cultivated it just for the above mentioned reasons. Of the eighty-three different species of the lupine only three have thus far been used for agricultural purposes, viz., the yellow, the blue and the white. The yellow lupine is the best adapted to cultivation in this country. The month of April and perhaps the beginning of May will be the best time for sowing; but it should never be done before the grass begins to grow, as the plant is very sensible of night frosts. About two bushels should be sown per acre. The plants grow three or four feet high. The plowing underground of the green lupine can be done during or immediately after the flowering. In Prussia the farmers first employ a large roller to crush down the plants, and then commence plowing. Of course, a field where so great a mass of herbs is embodied has not a very smooth appearance. This done, wheat or rye or any other winter grain can be sown immediately, or, as it is more customary, after working it a fortnight. The harrowing of the grain must never be done across the furrows. It must be parallel with the furrows, beginning from the opposite side whence the plow started, otherwise the lupine roots will be torn out and the land assume a hilly appearance. The secret of the fertilizing quality of the lupine is to be found in the following observations: First, the root of the lupine, which contains a large quantity of moisture similar to the turnip, absorbs more energetically than any other plant the phosphate of iron and natural ammoniac of the soil, thus making the latter digestible and accessible to other plants; second, it dissolves the chemical constituents of minerals by the evaporation of its roots, which is impossible to other plants. Thus the impure soil becomes enriched with a humus containing ammonia and a considerable quantity of alkali, phosphate, etc.; so great is the effect, that after manuring with the lupine for two or three years the soil will assume a darker color; third, what has been said about the root applies equally to the plant. It has the capability to absorb in an increased measure nitrogen and carbon out of the atmosphere, and does not draw upon the humus for its development and growth. The lupine communicates its oxygen as azone, forming thereby in the air that surrounds it, ammonia containing nitric acid, something which partly benefits the lupine itself, partly the soil, and also those plants growing in the immediate vicinity and needing manure. As during the first years of its introduction the lupine will chiefly be used for manuring purposes, it will hardly be worth while to say much at present of its value as fodder. It being a very rich and nourishing plant, great care must be taken to prevent sheep and cattle from eating too much of it. After rain sheep should not be permitted to graze on a lupine field. The lupine in this respect should be treated just as clover, vetches, etc. Some years since a large quantity of lupines was imported from Europe by the Commissioner of Patents, and distributed throughout the country; but the quantity sent to each was in such small quantities that a thorough trial of its capabilities could not be made. We would advise that a number club together and get some seedsman to import a quantity for a practical test on some of the soils that have become impoverished from the practice of taking all from the soil and returning nothing to it. We doubt if any quantity could be procured from any of our seedsmen.

Adjourned.

April 4, 1871.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

APPLICATION OF MANURE.

Mr. A. Brands, Delaware Station, N. J., made inquiry as to whether it is better to leave manure in heaps on corn land until just before breaking the sod, "or should it be spread as soon as the frost is out of the ground before it becomes much dried out?"

Mr. Frank D. Curtis.—In the fall, manure should be spread on the top of the land, but in the spring it is better to plow it under, as the sun will dry it up, and, as a general rule, all raw or fresh manures should be plowed in.

Mr. C. D. Bragdon.—I have seen good results from manure, very coarse, spread on the surface and dragged in. The crop gets the benefit on the start, and that is the time it needs it the most. On heavy clay soil the mechanical effect of plowing in coarse manure is excellent.

SUGAR BEET IN NEW ENGLAND.

Professor C. A. Joy, of Columbia College, presented the following notice of a work just from the press, entitled, "Report of Experiments on the Production of Beet Sugar in Massachusetts," by Charles A. Goessman, Professor of Chemistry at the Agricultural College, Amherst, Massachusetts. Dr. Goessman has subjected the question of the economical cultivation of the sugar beet in this country to a searching investigation, and his results are embodied in a report to the Legislature of Massachussets, from which I abstract some of the salient points for the benefit of the farmers of the country: Of the total amount of sugar consumed in the world, 66.47 per cent is derived from sugar cane, 27.87 per cent from sugar beet, 4.29 per cent from palms, and 1.24 per cent from sugar maple. The quantity of sugar sold in 1867 was 5,140,000,000 pounds, representing a value of $360,000,000, from which it appears that the beet sugar industry is worth $100,000,000 annually. How far it may be feasible to introduce an industry of this importance into our country is well worthy of consideration. "The sugar produced in the United States is far less than the amount consumed, leaving a heavy balance for importation. The production of sugar cane in Louisiana and Texas never exceeded 450,000 hogsheads, besides 20,000 gallons of molasses. The maple sugar production may have reached in favorable years from 20,000,000 to 25,000,000 pounds. The sorghum plant has thus far yielded, with but a few exceptions, only molasses, while the cultivation of the sugar beet for the manufacture of sugar has just begun to attract attention as worthy a more thorough trial in various parts of the country. Dr. G. says the rules by which beets are successfully raised for feeding purposes do not apply to a successful production of the beet for sugar. In the first case, quantity is the main aim; in the second, besides quantity, a good quality is essential. A good sugar beet is expected to contain not less than twelve per cent of sugar, a small per centage of saline substances, and the least possible amount of nitrogenous and non-nitrogenous constituents. The more nitrogenous compounds are present, the less sugar will be noticed; for they exert a controlling influence on the formation of sugar in the growing beet root. The saline substances, on the other hand do not affect injuriously the formation of sugar; yet they place it under very disadvantageous conditions, as far as its final separation in a crystallized state is concerned; they favor the production of molasses, and thus increase the manufacturing expenses. The history of the beet sugar industry of later years is not without many illustrations of these damaging influences. Some late experiments in this country, no doubt, owe their failure, in part at least, to the fact that virgin soil, rich in vegetable mold and saline constituents, has been used for the cultivation of the sugar beet. The best soil for the cultivation of sugar beets is a mellow, deep, sandy loam, with a free and permeable subsoil, a soil named by German agriculturists as rich, first-class barley soil. A sandy loam, if deep and rich in well decomposed organic matter, is preferable to a clay soil, for the latter becomes too compact and hard in a dry season, and in wet seasons it produces a watery beet of inferior saccharine properties. In case the subsoil is not perfectly free, under-drainage becomes indispensable. A stony soil, or a thin surface soil, with gravelly subsoil, or a deep virgin soil with large quantities of half decayed vegetable matter, are very objectionable; and stagnant waters cause the premature decay of the roots at their lower termination. Favorable physical properties of the soil are of the first importance, for fitness of the soil, as far as a necessary amount of plant food is concerned, may be secured by a carefully selected system of rotation, supported by a proper selection of special manures. Inferior kinds of soil may, to a certain degree in some exceptional cases, answer for beet sugar cultivation, yet they ought not to be solely relied upon as a safe basis for beet sugar manufacture. A moderately warm and moist climate seems to be best adapted to this crop, the northern sections of Germany and France being considered more successful than the southern parts of those countries. This observation may find its confirmation in the United States. Whether a change from Wisconsin to California merely on account of a warm climate would be a judicious move, future experience may teach, but past experience does not point in that direction. The rules for preparing the soil may be summed up as follows: Manure in the fall, and plow the manure in deep; use only well-rotted compost, if you are obliged to manure in the spring; begin the work in autumn at any rate, and turn the soil two or three times; do not work the soil when wet; pulverize it with the best implements, and as soon as possible; let not much time be lost between the best mechanical operation and the seeding. Stable manure is the basis of the whole system of manuring; commercial or artificial manures are only relied on as an aid. For this reason sugar beets are usually raised as a second crop, giving a chance for a thorough disintegration of stable manure; the effects of the latter is supported in the second year previous to the planting of the sugar beet, by a special commercial manure. The condition and the composition of the soil, quite naturally, control the whole system of manuring. To enter upon a detailed calculation of what our expenses for the production of the above articles per acre would be, could be at best but a mere approximation. It may suffice to keep in mind that in Europe from forty-six to fifty dollars per acre has to be paid in taxes to the government; that our lands are cheaper, and that machinery is taking daily more and more the place of the hand in planting seeds, in cleaning the fields, and in securing the juice from the beet roots. Where the final pecuniary results may differ so widely, as must be quite apparent from previous statements, in consequence of a more or less favorable location of the factory and the skill engaged in its management, it is unsafe to state a definite sum of profit. It must here, as in every similar instance of an industrial enteprise, suffice to know that money can be made if the business be intelligently managed. As far as the farmer is concerned there is little risk. While the profits of the beet sugar manufacturer may be lessened by changes in provisions of political economy, the farmer is not necessarily subjected to influences of that kind. In this case, he is aware that root crops are profitable, and that, aside from this, his farm lands will receive a treatment which has everywhere been proved to enrich rather than to exhaust the soil. To restore his lands to something like its original productiveness, and to do this mainly through capital furnished by outside parties, is worthy his serious consideration."

COLORING CHEESE.

Mr. De Cordova exhibited specimens of annatine for coloring cheese, and distributed samples of cheese which had been colored by his process, and which the farmers ate with becoming dignity. He claims that by his treatment of the anatto bean the bitter taste is not introduced into cheese and butter, and that his paste is much less injurious than the yellow often used.

Mr. Frank D. Curtis.—The gist of the whole question is this: The markets in this country and England demand a rich-looking, yellow cheese, more highly colored than milk will allow it, unless it all be made of Alderney milk, and this is impracticable. Anatto takes the place, and is used everywhere to give the desired color. The article prepared abroad is said to be adulterated. Unless the interested foreigner is more honest than the majority of Yankees, he does mix his anatto, and if he does, it is impure and proportionately unhealthy. Mr. De Cordova claims to have invented a process by which he can extract the coloring matter from the anatto bean and have it free from sediment and perfectly pure. If he can, he has done a good thing; for since we are bound to have this coloring matter in all our cheese, we want it as pure as possible. There are often cases of poisoning from eating cheese, and perhaps they arise from the poor material put into the anatto.

Dr. Isaac P. Trimble.—I am glad this subject has come up, for I want to enter my protest against coloring them at all. I think it is all wrong; and as it does not improve the taste of the article, where is the necessity of doing this foolish thing? I had the pleasure of exhibiting some cheese here a short time ago which had no coloring in it, and it was good, some say splendid. This was made from pure milk from Alderney cows. I would use Alderney for my coloring.

MILK CELLARS.

Mr. J. B. Lyman.—Sixty-two degrees for milk is understood among all intelligent butter-makers as the charmed number for the coolness of a milk-house. Some go into deep cellars to get earth cool enough to keep the milk at sixty-two degrees. Some are so fortunate as to have a cold spring not too far from the farm-yard. This is walled and cleaned and paved. The walls are whitewashed, the floor is scraped to remove mould, pits are sunk to get the coldest bath for the cream pails; all to secure for milk, cream and butter that charmed degree. Some weeks since you appointed a committee to go look at Mr. William Crozier's Beacon farm, at Northport, twenty-five miles east of this city, on the northern margin of Long Island. We found there an admirable system of farming, and saw a great deal that we consider a good pattern for the whole farming world to copy after. We referred to Mr. Crozier's milk-house, and this part of our report is confined to that feature of his economy, because we count this also a model. The walls are thirty-six by eighteen, and it is divided into ice house, milk room and butter kitchen. On one side of the latter is a small gallery, and a closet opening on the gallery; on the other side of the kitchen or churning room is a sink supplied with water from a pump; the middle room is the milk room, eighteen by sixteen, with four steps going down to a concrete floor; in the center is a stove, and a broad milk shelf extends all around; adjoining is the ice house, with tubes conducting the cold air into the lower part of the milk room; these tubes or conductors go down from the upper part of the ice house. They are made of boards eight inches wide and an inch thick, with many holes bored in them. The holes allow the cold air to enter from the ice, and it pours in a stream from the mouth of the tube into the milk room. The temperature of the air as it comes out at the mouth of the tubes is about thirty-five degrees. As the milk room has thick walls and the windows are high, this flood of air at thirty-five degrees is able to lower the mercury to sixty-two degrees, and even lower, in July. Sometimes he closes one tube to keep the room from growing too cold. The draft is the strongest in the hottest weather. In spring and fall there is little current, and in winter, when the fire in the stove is constantly burning, the draft would be the other way. But then the mouths of the ice tubes are closed. By this arrangement the desired temperature is secured the season through, and there is no difference between the June butter and his January butter. He makes June butter the year round. The stonework was much of it done by farm hands; the hemlock cost twenty dollars per M., and the pine thirty and thirty-five dollars. The whole building cost him $650. He gets ten cents a pound over the highest market price. Making, say, 200 pounds a week, his gain is twenty dollars per week by having the best arrangement for butter-making. Thus his milk house pays for itself every nine months, to say nothing of the greatly increased facilities for doing work afforded by a pump, churn and stove so convenient. He consumes about a ton of anthracite in the four coldest months, and a slight allowance is to be made for wood used in summer to heat water for washing and scalding. Your committee could see nothing wrong and much that was exactly right about this house and this system; and wherever ice freezes to the thickness of three inches and over, it may confidently be recommended to every butter-maker who milks a dozen cows.

J. B. LYMAN,
FRANK D. CURTIS,
Committee.

BURN BIG BOULDERS.

Mr. Elias Burnell, Franklin, N. H., gave it as his opinion that it is better to burn than to bury the granite rocks of which one may desire to relieve his fields. Make a slow fire across the rock in the direction in which you wish it to break; keep it up for one hour, more or less. When the rock begins to heat thump on it with the point of a bar where it is hot, and if it has started a scale, remove it, and keep up your fire as before. The heat will swell the rock near the fire, and if the rock is sound will crack it where it is not hot. If you do not believe it will crack the rock, put your ear to it while the fire is burning and hear it crack. One man will break more hard rocks with fire in that way than a half dozen with drills and powder. Wood does not cost more than powder. You need not throw on water, as that will not do the least good. I do not know anything about writing for a paper, but can hold a plow as well as any of you.

SOUTH-WESTERN IOWA.

Mr. Henry T. Williams, just in from Omaha, gave the Club a glowing account of the wonderful growth of South-western Iowa. He says that a great reach of country through which some members of the Club traveled last July and saw it a wilderness, is now dotted all over with farm houses and herds of cattle. The wave of emigration is rolling westward with a velocity and in a volume never before equaled. Men have been dreaming of a half section or quarter section to be enhanced in value 1,000 per cent by a few years' work, will find that while they have speculated others have acted, and have laid the basis of a fortune by it. He found a rolling country thirty to fifty miles east of Council Bluffs, and thinks that for beauty, fertility, health, and ease of access it is not surpassed by any section he has visited. He likes that part of Iowa better than the eastern country, and better than Illinois, because the subsoil is more porous and the drainage much more perfect.

Mr. E. Meeker, Olympia, Washington Territory.—I have been surprised, Mr. Chairman, at the ideas of some whom I have met in the eastern towns. They seem to think that an old community with deep ruts in the road and mossy fences is something to cling to, and to be greatly preferred to the freshness, and freedom, and hope of a new community. We are apt to forget that for the loss of such, a corresponding compensation will arise in some new form, and that after all there is real enjoyment in all the conditions of life, and that a contented mind is almost the whole sum of pleasure. I have myself experienced as much exquisite pleasure in reading the proceedings of this Club 3,000 miles away as I have in listening to your most fascinating lectures. I have been a member of this Club from its first inception, and have participated in its discussions just as regular as its attending members, the only difference being that my part would be enacted under a shade tree during the noon-spell or in the cool shade of evening. A homely cake and a broil of venison, before a camp-fire, or in the cabin after a day of activity out of doors, tastes just as well, and I may say better, than the most luxurious meal to those leading a sedentary life or sickness for want of pure air. Fatigue brings pleasure and rest, activity, health, and comfort, with its engagements of a keen appetite and refreshing slumber. If we lose in part the variety of food, we gain in its freshness and purity; in a word, where there is a loss of supposed comforts there is a gain of real enjoyments; hence we can say, do not halt in your resolution to go west for fear of losing the comforts of life. If you cannot join with a colony, go alone. If you cannot take a fortune with you, go with what you have. If you have willing hands and a stout heart, you cannot fail. The government gives you land for residing upon it, and should you but make a living you will soon have a valuable property in your land. You will have no rents to meet or overseers to control you, but will be free in the fullest sense of the word. If you do not have means to purchase a team, your neighbor will gladly loan you one or exchange work with you. I tell you that where there is a will there is a way. Western men know this by experience, and are insensibly led into coöperation even without organization.

The life of a pioneer is not a cheerful one. In my country you can have game and fish in great abundance for the taking; vegetables are to be had in the greatest profusion and of the finest quality. So likewise with fruit. All kinds of fruit trees bear so young that the question among us is how to prevent early bearing, and give the tree time to lay on wood. An emigrant can have fruit the second year from planting. As for small fruit, there is no end to the variety, both cultivated and wild, and no stint as to quantity. It will cost less than $100 for an adult person to get from New York to Puget sound, sixteen dollars will pay the office fees for a homestead; industry, frugality, and perseverance with God's best gift to man, true freedom, good health, and a contented mind.

BONE-MEAL ON POTATOES.

Mr. J. Levally, Summit, N. Y.—I wish for information through the Farmers' Club in regard to the best way of applying bone-dust to potatoes, whether to put it on the potatoes or on the hill, and also the quantity.

Mr. J. B. Lyman.—There are eight barrels to a ton of true bone-dust. If he used a barrel to the acre it will be about as much as the plants will stand. I would make a compost of bone, wood ashes, plaster and salt, and mix a handful of it with the earth in the hill before covering the seed. But I do not consider bone a special application on the potato. It pays better on corn and spread on grass lands.

MOWING STRAWBERRIES.

Mr. Ira Smith, Peoria, Illinois.—Observing frequent inquiries made of the Farmers' Club regarding the propriety of mowing strawberry plants after fruiting, and that the members have been rather shy in giving an opinion, I offer the following experience of my own: About ten years ago, noticing, as had frequently occurred before, that after fruiting, the weather being hot and dry, many of my plants, apparently fresh and healthy in the morning, would lie flat on the ground, withered and seemingly nearly dead at night, as though something had severed the roots and cut off the supply of moisture. This being often repeated for a month, half of the plants would sometimes be dead and the rest greatly injured. All strawberry growers have witnessed the same. It is called here sunscald. On examination I found the root whole, sound and in good order, except as dry as a chip. The following hypothesis was then suggested to my mind as the probable cause: After putting forth their utmost strength in the production of a bountiful yield, the plant now, like all else of animated nature, including man, and, from accounts, divinity itself, requires a season of rest, and cannot at once replace the exhausted energy of the rootlets so as to gather in sufficient moisture to meet the excessive demand for evaporation from the leaves. The roots thereby being sucked dry, death necessarily follows from starvation. The remedy, then, must be in removing the demand for evaporation. The test was made by mowing a portion of the patch close down, and was attended with perfect success. Since then my practice has been, after fruiting, to mow them close to the ground, and if the weather is hot and dry, scatter the leaves evenly over the beds, and after thanking them for their nice acid fruits, bid them rest in peace until August and September showers come with their life-restoring influences. Under this treatment I never lose a plant, however hot the weather may be. After August rains they recommence to grow, putting out no new runners, but covering the ground with large, dark, thrifty foliage, and the largest and freshest new crowns for the next year's crop, and never fail in giving a first-class yield for the season.

Adjourned.

April 11, 1871.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

RENOVATING WORN LAND.

Mr. John Ridgwood, Manchester, Mass., made inquiry on this subject, and Mr. D. Barret, Machias, Maine, also desired to hear discussion.

Mr. C. D. Bragdon.—Turn under peas, clover or buckwheat.

Mr. John Crane.—I agree, except the buckwheat. That I have found a poor crop for this purpose. Oats answer well, but peas are better yet. But he might start with some guano or other fertilizer.

Mr. Frank D. Curtis.—Manure is the best medicine for worn-out land. In the absence of this, plow up deep and sow with peas or buckwheat, and turn it under when the crop has attained full growth, and then sow with rye and seed in the spring with clover. Take off the crop of rye and leave the clover until the second year, and when it is in blossom plow that under and sow with wheat or rye again, and seed with clover. In this way the land will improve. After the second crop of rye or wheat has been taken off, the land will usually be in good enough condition to plant with corn. Sow plaster on the clover each year.

TO KILL WILLOWS.

Mr. Bryan Tyson, Washington, D. C.—Cut through the bark with a light hatchet or drawing-knife about five or six feet from the ground. Then strip the bark down to the ground in pieces two or three inches wide, leaving it fast to the tree at the bottom. This can be done in May or any time when the bark will strip well. Toward the latter part of summer, or any time thereafter, the trees may be cut. Some will die previously, while others will remain green throughout the summer. But whether the trees be dead or alive when cut, their stumps will never sprout.

FENCES.

Mr. R. M. Stennet, Keswick, Ontario, Canada.—I live away back in the woods of Canada, but am a farmer, therefore take great interest in the reports of the Club, and having seen a great deal about fences and hedges, thought I would like to tell how we make almost beautiful hedges here that will stand any degree of cold, and cannot see why it would not answer any place where the cedar will grow. We dig a ditch about one foot deep by two feet wide where we want to make the hedge, then go and cut down second growth cedars (out of thick clumps or clusters are best, they having most all the branches on one side), about three or four inches through at the butt; take branches and all and lay them in the ditch, with the thickest branches up; turn up the branches so they are (that is, the branches) not more than eight inches apart, and if there are not enough on one tree, lay down two side and side, butt and top together, then chop off all branches that cannot be got to lay in the ditch to about ten inches long or so, so that they will cover up; then cover up, taking a little pains to stake and bend the branches that are to form the hedge into a straight row, or nearly so; cover about two-thirds up, then water and finish covering, and, with a very little trouble, in five years the hedge will be so thick that a hen cannot get through it or sheep or cattle get over it, and will get stronger and larger every year. Where small second growth cedars cannot be got, small trees will answer nearly as well, or even sow the seeds, which is a rather slow process, but sure. Small trees of all kinds of evergreens are plenty in this section of country, and are easily shipped. Then we have tried all sorts of fences, and find none as durable, cheap and convenient as cedar posts set seven feet apart, and four or five boards well nailed on, and where lumber is not too scarce, a board nailed on the top after the posts have been sawed off even, makes a nice finish. We have fences of this kind near here that have been standing thirty years, and one was renewed last year that had been standing forty-three years, and many of the posts were good yet. This fence may cost more than some others in the first place, but if the posts are good and sound and dry, and the boards good, that is, not too much sap in them, and sound, it is a good fence for forty years, therefore cheap.

Organized Migration.

This subject was considered in the following paper presented by Mr. J. B. Lyman: Railroads can be used in such a way, Mr. Chairman, as to divest pioneering of nearly all its hardships. The people are not duly alive to this fact, and railroads are not awake to the possible combinations and arrangements by which they can serve the public and indirectly put great wealth in their own pockets, by converting the wilds through which their tracks have been laid into productive farms. Suggestions from this Club will meet the eyes of a great number of persons who intend to move west, and of thousands who ought to move west. We think there are methods vastly superior to the old way, as much better, as the locomotive is swifter than the ox-team. All the country west of the great central river of this continent is now belted with enormous grants to railroads. There are those—some, I think, of our number, who believe Congress has made a vital and far-reaching error in putting such vast areas in the irresponsible control of powerful and soulless corporations. True, these roads have shown amazing enterprise and vigor in the rapidity and confidence with which these cast-iron belts have been pushed across wide solitudes. Without these iron tracks the great grassy plains between the river and the mountain would have continued for another generation or longer a range for buffalo, and the hunting ground of barbarians. It is also true that enormous wealth has been placed within the grasp of a few stockholders; that control and ownership of immense areas of land are placed in their power, and there is danger that Congress has created beings that will be found superior to its control, and able eventually, Warwick like, to make and unmake kings and mould the legislation of a continent. We will not now discuss the wisdom or unwisdom of these grants. It is sufficient for us to say that the Union Pacific, the Kansas Pacific, the Northern Pacific, and the Texas Pacific routes have received from Congress the alternate sections on each side of their roadway for twenty miles. The Illinois Central, the Chicago, Burlington and Quincy, as continued through southern Iowa to Omaha and Plattsmouth, several roads in Kansas, and a long transcontinental route connecting St. Louis with San Antonio, have received similar grants. The only way in which mischief can be prevented in making these corporators enormous land monopolists is by a copious flood of agricultural emigrants advancing at once upon all such lands as are capable of tillage. Many do not know, or if they ever knew, have forgotten, that these belts of land are laid out in checkers of a mile square. The odd squares belong to the country; the even squares belong to the railroad. These odd squares cannot be bought by anybody; they are reserved for homsteads. Any family man can have title to an eighty acre homestead by going and settling on it. Any soldier in the late war who can show an honorable record, receives twice as much as an other citizen; he gets 160 acres. This soldier homestead law was passed in the summer of 1870. When a company of colonists form for establishing a town on or near the line of one of these roads, there will be at least four classes as relates to the acquisition of land.

First. The veterans of the civil war; they can pre-empt 160 acres.

Second. Those who did not fight; they get eighty acres.

Third. Those who have means and can buy of the railroad.

Fourth. Those who can pre-empt either eighty or 160 acres and buy other land adjoining of the railroad.

On what terms will the railroads sell? Different companies have various ideas and rules, but vast areas are sold at an average of about seven dollars an acre, the prices ranging from three dollars for the remotest to fifteen dollars for those near the track. This price is in no case required in cash. The usual terms are the interest for the first and second year, one-eighth of the principal the third year, and one-eighth each successive year till all is paid. The railroads do not in all cases go through the very pick of the lands, but they furnish as good as the average; and the ease of access and convenience and cheapness of freights counterbalance all questions of intrinsic difference. These facilities for securing homes and farms in the west, are swelling the tide of emigration that is overspreading those immense grassy plains, at a rate never matched in former years or by other countries. What I urge is that these migrations be systematic and colonial, rather than solitary and single-handed. Combination will strip moving west of all its terrors, its hardships, and its tedium. It is a time now to begin and form associations for going west, soon after haying. The fall is nearly as favorable as the spring, especially if the State selected is Kansas or southern Nebraska. A very suitable size for a group or colony is 100 families or homesteaders. The railroads will give special aid to groups as large as this, and the expenses of moving and settling are greatly reduced. The best organization is the following; scores are following it, and it gives satisfaction and results in a cheerful success:

First. Circulate a paper by which each person proposing to go agrees to give five dollars as soon as 100 sign.

Second. When $500 are thus subscribed, call a meeting and elect a locating committee. This should consist of three — one, a man of good address, and full of ideas, apt and shrewd in making contracts with railroads. The second should be an excellent judge of land, and the third should be a physician, and able to select a situation free of local causes of disease. The railroads which they go over will afford every facility and give full information. Their duty will consist mainly in a candid and impartial canvass of the claims of a score or more of locations. As soon as their judgment is formed they must have a list of all the members, and know which can only enter on eighty acres, the soldiers who may claim twice as much, and those who, in addition to their pre-emption can buy more or less land off the railroad.

Third. In order to prevent jumping and forestalling, they must enter these lands and engage for them according to the instructions of the different members, it being understood that upon coming to the location the members can bid for choice, and each man's location is to lie open to the bidding. This gives all a chance at a choice by paying for it. The money gathered in this way should compose a common fund, and go for streets and school-houses.

Fourth. A few should go out as pioneers, and erect tents, dig wells, and put in crops enough for food. At a concerted time the colony follows, and at Chicago or St. Louis a special train can be made up, with freight cars for all the household goods, farming tools, seeds, and even for stock. If the train is a quarter of a mile long and two engines are needed they can be had. The leading man of the colony can, by seeing the proper officers of the road, have every such arrangement perfected. The fare will be a third or a half of the usual rate.

Fifth. In going west of the Mississippi, the dependence for lumber is upon the pineries of northern Wisconsin. The best plan is for each family to decide upon the size and style of the house they can afford, and give a bill of the lumber. These bills can be added, and the sum total for 100 families would be as high, perhaps, as half a million of bill lumber for houses. This half million could be contracted for on Wisconsin river at the lowest wholesale rates, and special prices would be granted on river and car freights. One good architect could write specifications for all the styles. A convenient and tasteful farm-house would thus be secured to each colonist, and it would be as cheap as the shanty that he would erect with great pains and at countless disadvantages if he went out a solitary pioneer. This sketch is not a dream of the fancy. Colonies are now forming in nearly every State on a basis and with a system substantially after the details above given. By following them 10,000 eastern and middle State farmers can exchange a small farm of poor worn land for a large homestead, with soil as fertile as any that is wet by the dew of heaven.

Mr. C. D. Bragdon.—Cannot a man not a soldier have a homestead of 160 acres?

Mr. J. B. Lyman.—Yes, if he goes beyond the belt of twenty acres granted in alternate squares to railroads. Inside that belt the government land would be held at $2.50.

CRANBERRIES UPON UPLAND.

Mr. A. J. Hinds, Patchogue, L. I.—Having heard so much about the successful cultivation of upland cranberries, or cranberries on upland, at North Islip or Suffolk Station, on the Long Island railroad, I finally constituted myself into a committee of one and drove up there, some twelve miles, to see for myself. For a mile east of the station there are several patches. One Mr. Hale has four acres, a German by the name of Moos has two and a half acres, and has another large patch all dug up by hand, cost sixty dollars per acre; and so afraid are they of manure or ashes that all roots are carted off the patch to be burned. Suffice it to say, for one, I never in my life saw handsomer vines more thoroughly matted. I learned that they did not bear always satisfactory. Year before last they only had sixty barrels off four acres. The land is quite loamy. I advised to manure with white sand, one or two inches spread evenly over the surface; this will make them fruit. I might have told them they could have had a better kind or variety of vines, for there are as many different kinds or varieties of cranberries as there is of apples. Still they find it more profitable as they are than anything else that they can raise. Now, if any one at all interested in this subject will just go and see for themselves, all skepticism will be removed of the entire success of the business on upland.

PLANTING A PEAR ORCHARD.

Mr. S. Pearce, New York.—I am planting a pear orchard on new land, cut off three years ago. The stumps are oak and chestnut, from which the sprouts were thoroughly removed last year. I have dug holes for the trees three feet by three, two feet deep, and loosened the earth with a fork eight inches lower. The soil is all alike from top to bottom; a fine yellow sand and clay, not too sandy, nor clay enough to hold water. I have manure and marl, composted one year ago, raw blue marl and ground bone. There is also on the ground and in the adjacent woods plenty of leaves, twigs and small roots partly decomposed. My trees are one year old. How shall I plant them so as to make a good growth reasonably certain?

Mr. John Crane.—Fill the holes half full of soil. Then make a compost of the materials he mentions.

Mr. C. D. Bragdon.—Put manure on the surface, and don't set the trees deep.

Mr. Frank D. Curtis.—Mix the manure with the soil, and put it carefully around the roots, and then top-dress the ground around the trees for three or four feet with the leaves and twigs spoken of. They will keep the ground light and moist, very essential points in connection with trees. The stumps of the old trees will do no harm; but, on the contrary, as they decay feed the roots of the young ones and lighten up the soil. When a man has a good many trees to set out let him prepare a compost for them some months before. The best compost for orchards is a turf pile mixed with a little quicklime spaded over once or twice till it is fine and even. Throw a wheelbarrow load of this on the spot and mix it well with the common earth. Then use a little good bone dust for each tree, say a quart, well raked in. You can't be too particular about setting out trees.

Adjourned.

April 18, 1870.

NATHAN C. ELY, Esq., in the chair; Mr. JOHN W. CHAMBERS, Secretary.

A FARMER'S EXPERIENCE.

Mr. D. H. Moore, Schenectady, N. Y.—I have read the proceedings of your noble society for a number of years with very great pleasure as well as profit. The experiments made by wealthy gentlemen, who are better able to stand the cost than I am in case of a failure, has saved me quite an amount of money; and if my forty years' experience in farming will serve to amuse, or benefit, or elicit profitable discussion, then I am amply paid for my writing. My farm is located a few miles north of Schenectady; the soil is a clay loam with some stone, underlaid with clay slate; the timber mostly oak and hickory, some pine and chestnut. I use no artificial fertilizers. The late Judge Buel of Albany taught me to sow plenty of clover and turn it under about the second year, which proves to be all sufficient to keep the land in good heart. I hold to Mr. Greeley's deep plowing, but it may not be good on all soils. The first settlers of this valley had a very true and trite saying, that we should

> "Plow narrow and plow deep,
> And we shall have corn to sell
> And corn to keep."

I have no faith in the influence of the moon in sowing or planting, or weaning babies. Solon Robinson settled that by the ridicule it deserved. The idea of recruiting an old orchard is something like an attempt to rejuvenate me at seventy years of age. In planting potatoes, I find that it makes very little difference whether we plant large or small ones, if they are ripe; if they are cut they spread around better, and make a better hill.

Your suggestion in raising forest trees has waked me up. I have a lot of seven acres which has been cut off from year to year for fuel, and the cattle kept out; the sprouts come up and grow very fast; I leave them standing thick so that the grass is kept out, or the trees would have a very slow growth. I set out some where a vacancy occurs, then the ground is kept properly mulched with leaves.

I have no special rule for curing hay, the weather is too variable for that. I choose to cock it over night when I can. We Americans are getting so lazy that if it was not for the improved implements (many of them the result of your society's getting up and testing by actual trial) the farmers would not raise enough for their own use. I sell but few eggs; my men rather have pork and eggs than fresh meat, especially veal. I follow your recommendation in transplanting young trees, and adopt the plan of Judge Buel in his answer to an inquiring friend, when and how to trim young trees, his reply was, "when my knife is sharp I cut off such limbs as should be removed." Plaster or lime does but little good with me. Rolling seed corn in plaster does some good; a little coal tar added keeps off the crows. Go on, gentlemen, with your benevolent work, and the next generation will honor your memories. It takes a long time to eradicate old notions, especially among farmers. Your object in elevating the character of agriculturists, to teach them how to get the most from a given amount of labor, begins to be appreciated already.

WHAT IS GOOD LAND.

Mr. T. C. Peters.—The other day I was preparing an agricultural essay, when the question, "What is good land?" presented itself for answer. What constitutes first-rate land, and what shall we consider second and third-rate? It proved a stump I couldn't plow around, and so I have taken the liberty to invade the circle of your solemn Club, remembering that amid a multitude of counselors there is wisdom.

The Chairman.—My opinion is that we have here the man best fitted to give instruction on this as well as on most other farm topics.

Mr. T. C. Peters.—You mean George Geddes, of course, but he can't answer because he has no poor land. His is the best in the State of New York, a limestone soil.

Dr. Isaac P. Trimble.—The question of Mr. Peters is too general to be answered satisfactorily. There are soils naturally containing all the elements of plant food, formed by the disintegra of minerals. Prof. Cook, of New Jersey, in his work on the geology of that State, speaks of the valleys in the north-west portion of the State as producing crops year after year, always equally good, where little manuring is resorted to and the farming indifferent. He has analyzed those soils and gives the constituents, and Mr. Peters can consult his work to advantage. Limestone, of course, is found in such soils. These valleys run into eastern Pennsylvania.

Mr. R. J. Dodge.—It depends on circumstances entirely. If grass is required, go to Orange county and find out by analysis the elements of that soil. If you want wheat, that is a very different thing; and potatoes require land still different for the best crop. You might as well ask what nation speaks language best—the French, the German, or the English.

Mr. C. D. Bragdon.—It seems to me a simple matter enough. Good land is land which will produce anything for any length of time without manure. Intermediate grades are those which yield more or less.

Mr. Geo. Geddes.—My definition of best land is that which produces the most good grass, and this, by the way, is not in Orange county, as has been stated, but in Otsego. Upon land which naturally yields good grass, I can raise potatoes or tobacco, or anything else.

Mr. H. L. Reade.—I consider that it would be impossible to designate soils as first, second, third and fourth qualities with any surety of conveying to any persons making inquiry respecting such soils the proper idea. No soil is fitted to raise to perfection all crops; therefore everything that is said about soils must be to compare them with others. Besides, some soils are best for corn, others for wheat, and others for grasses or other grains. If it was asked for the first quality of soil for any particular plant, that could be given, but not such reference to raising all plants. Mr. Geddes' idea that the best soil for grass is to be designated as of the first quality, will, perhaps, approach nearest an answer than any other. But this is open to the objection that the best grass lands may not be best for anything but grass, which, of course, would make it second or third quality, if some other crop was to be raised thereupon.

Mr. F. D. Curtis.—Soil which abounds in organic matter is the best, and land in which it is wanting is the poorest. The bottom lands of our rivers and valleys represent the first, and the white sands of the seashore and where the hard-pan comes to the surface exhibit the latter.

Prof. R. H. Colton.—It will not do to make the organic matter in soils the sole requisite, or even the chief. I have in the last two weeks seen a soil containing so much organic matter that it would not grow any crop. The owner went off from his plantation two or three miles and hauled in marl on this bed of peat—for it was little else—and then got from it a fine crop. Mr. Bragdon's position is the proper one. That soil is best which will produce any or all crops with equal ease, and, at least, in moderate quantity.

Cloth for Grafting.

Mr. J. C. Thompson displayed some branches in which he had inserted grafts, and also some pieces of cloth saturated with melted beeswax, rosin and tallow. The latter he wraps closely around the graft in place of the wax ordinarily used, and he never loses one graft in a hundred where scion and tree are in a healthy condition to start with. "I do the work in spring or in September. In preparing the wrapping take common muslin and immerse it in a hot solution of equal parts of the ingredients above named, and in applying it put it on close enough to exclude air and moisture."

Mr. D. B. Bruen.—I should think the plan a very good one, and less trouble than where wax is employed.

Poultry Breeding.

The Rev. Joshua Weaver presented an essay of considerable length, from which the following is abstracted: "Poultry breeding must have adequate facilities and proper attention; and were these considerations duly regarded, the keeping of poultry would be attended with just as much general success and profit as any other business whatever. And then this is just the kind of business for women. The most of the attention and work needed about the poultry farm can be as well, and perhaps better, given to and performed by women as by men. And as there are so few departments of out-door industry suited to women, this of poultry-keeping deserves especial encouragement by this Club on this account. The reasonableness of such business succeeding, when properly pursued, appears from the fact of there being such general and constant demand for the articles which it brings into market. Let any one establish himself or herself in the neighborhood of this city, and bring here well-fattened and well-dressed poultry and fresh eggs, and he could at any season, and at large price, dispose of any quantity; and in respect to early spring chickens especially, which ought to be an important part of such business, the profits would be very large. With proper accommodation these could be brought to market fit for roasting by the first of June. I always had young chickens out by the last of February and beginning of March, and then I had on my table fine, large, fat birds by the beginning of June. Such chickens brought here to market would command an extravagant price. But, as I have said, to succeed in this business there must be the necessary facilities and the necessary care and labor. Dampness, for instance, is a frequent cause of sickness and disease among fowls. It causes colds and catarrh, and finally croup. This latter disease, which is an epidemic or malignant catarrh, is just as unmanageable and destructive to poultry as is the cattle disease with cattle. Therefore proper precaution should be observed for preventing, if possible, its introduction into a yard. Very important it then is to select a dry position for a poultry house and yard. It would also be of great advantage in locating a poultry house, to choose a side hill with southern exposure, and underneath have a cellar, this cellar to be the living apartment for the fowls. Such an arrangement would insure them a warm place in winter and a cool retreat for summer. A shed or porch might also be run along in front, and glazed, so that in severe weather the fowls could be kept confined, and yet enjoy the light and sun. This house should be well finished and plastered, so as to leave no harbor for vermin. Useless it is to undertake the breeding of poultry with any hope of success, unless the care and labor required to keep them clean and preserve them from vermin has been duly estimated. This care and labor will be largely diminished by so constructing the poultry house that it may be easily cleaned. Then poultry need a sod or green field over which to range, and from which to gather green food and insects, which are requirements, and which no artificial feeding can fully supply. In England not only profit but fortunes are realized in this business; and in France it is prosecuted by the peasantry very extensively and very profitably. The amount of poultry and eggs sent into England from France is enormous, and has been all along a source of large revenue to this latter country. It can also be made, I am sure, a most successful and profitable business here, on a large scale. For what department of business in this country has not, within the last quarter of a century, enlarged beyond belief and expectation? And is it not now the aim and effort of men in every department to increase their business to the largest possible extent? And this, too, for the very purpose of making it more profitable, and securing larger returns! Then why may not the same rule apply to the poultry business? There is no reason in the world why it may not. I appeal in this particular to my own experience. My premises were very limited, and yet I found no difficulty in keeping with entire success three and four hundred chickens, old and young; and I could have doubled the number with just as much success by a very little increase of accommodation and care. Keeping poultry, then, in large numbers, and as a distinct business, if it be engaged in with a proper comprehension of the business and adequate facilities for conducting it, would no doubt be attended with good and satisfactory results. Either in this way, or as a partial business with which something else might be joined, it is one in which many might employ themselves to better advantage than in dreaming away their lives in visions of extensive possessions and great wealth in new and remote parts of the country, where, even though articles for subsistence and manufacture may be produced cheaply and in profusion, they are yet of little value for want of a market. Quite sure I am that with twenty-five acres of land in the neighborhood of New York city, or of any other considerable city, there might be realized a larger profit in this business than on 2,500 acres there could be by breeding cattle or producing grain in Texas, Nebraska, Oregon, or any such far off from market localities.

Mr. D. B. Bruen.—I may have said before, that in my opinion there is no part of a farmer's business which can be made more profitable than poultry raising, provided it receive the attention its merits deserve, and the same I would dare to maintain. However, it is nonsense to attempt to keep fowls confined in houses or by high palings. They must have free range, and that is proved by Warren Leland's practice.

Prof. R. H. Colton.—The paper we have listened to is very well written and interesting, but to follow out the suggestions contained there of going into the poultry business alone on twenty-five acres of land, near New York, would be the greatest folly. The quantity of land is not large enough, and land here is too costly. We have pretty well settled that question before. No one doubts that with a few hens in connection with a farm; raising poultry is profitable, but as a business alone it has not been demonstrated, and the gentleman gives us no statistics or practical information to sustain his point.

Mr. Henry T. Williams.—It may be an item of interest that Maryland and Delaware, largely as they are engaged in fruit culture, still receive more income from poultry, and it is another fact that this poultry comes from farmers who keep usually about 100 fowls. In several instances where attempts have been made to keep very large flocks there has been failure.

Mr. Richard Cope, Cohoes, N. Y.—Would you advise a young man who is not strong enough for farming work, with about $1,000, to embark in the poultry business? If so, how much land would be required, and near what market would you locate?

Mr. Warren Leland.—I advise him to go in, but not to go blind or attempt everything the first year. I have had great success with chickens, and if he will take five or six rules from me, rules that it cost me many a dollar to learn, he is welcome to them: 1. Give them range enough. Allow not less than an acre to 100. 2. Keep their roosts and nests free of lice. This you can do with sulphur smoke and carbolic acid in the whitewash. 3. Feed high and give variety, wheat and oats, and scrap cake as well as corn. 4. Make the good mothers nurses and give them great families, and keep a separate nursery-yard sodded with grass that is not long. 5. Change roosters every spring. 6. See that they have plenty of dry ashes to wallow in, and use plaster to keep the roosts sweet smelling.

RAISING TURKEYS.

Mr. H. L. Reade.—For the last ten years a multitude of farmers east of the Hudson, and not a few west, have made more money from their turkeys than from any other one kind of stock. Ten well managed turkey hens will give a larger net profit than ten cows if, in addition to good management, the farmer has good luck. The first six weeks in the life of the young are the most perilous. After that time they are comparatively safe. Some men out of a batch of a hundred never lose one, and this is the way they manage them. Let the mother of the new-born brood choose her own time to leave the nest. Taking off is always bad policy. As soon as the nest is left make a yard twelve feet square by setting boards edgewise. Remove the turkey and her brood into this little pen, wherein they should be kept for at least six days. After which they may be let out in the middle of the day, and permitted the range of an acre; but they must always be gathered at least an hour before sundown into the pens to remain until the dew is off the next morning, and all the day if there is the least appearance of a storm. The time the mother leaves the nest, wash the naked parts of her body thoroughly with tobacco juice to kill the inevitable lice; and at the same time dust thoroughly the young with some vermin-destroying powder. No one thing kills as many young turkeys as these parasites. As a preventive, sulphur and snuff mixed in equal quantities, and dusted on the nest after the turkey has been sitting two weeks is recommended;

but nothing should prevent the washing of the mother or the dusting of the young the day the mother leaves the nest, and two days after the young have left the shell. Young turkeys require but little food, but they need to be fed as often as once an hour for the first week. Coarse ground Indian meal mixed with sour milk curds, and fine chopped hard-boiled eggs is the best feed for the first month. After that the eggs may be left out, the meal ground a little coarser, and the curds, if you have them, used in larger measure than at the first. As soon as they can swallow whole grain give them that, and then all trouble in this direction is at an end. Until they are two months old they must be driven to some shelter every night, and never be allowed to remain in the fields through a long or heavy rain. Even when one-quarter grown they will die from exhaustion, trying to follow the vigorous and unreasoning mother if wet with but a heavy dew. Three rules then must be observed if those who attempt to raise turkeys would secure success: First. Be sure to free both old and young from lice immediately upon the old ones leaving the nest. Second. Feed frequently at the beginning with strengthening food. Third. Never let the young turkeys get wet either with dew or rain until their feathers afford their bodies if not complete at least partial protection.

Butter Making.

Mr. J. R. Corbin, Whitney's Point, N. Y., kindly furnished the following reply to questions asked by Mr. E. N. Wales, Saguache, Colorado: Butter should be rinsed in cold water immediately after it is churned, and the water changed till there is not milk enough left in the butter to color the water; then it should be salted and set in a cool place and remain for three or four hours, when it should be worked some; then the salt will be partially dissolved and the grain of the butter much toughened, for it is always very delicate and tender when first churned, or is fresh, and it should be handled and worked at all times with the greatest of care and skill, or it will be made salvy, when no after treatment can restore the grain of it. If there should be milk in butter after it is salted, it should be washed in brine as soon as discovered; and it is better always to work it in brine for this reason, it will help to protect the grain of the butter, also to rinse out the milk or sourness that may be in it; therefore it will require as much working to extract the buttermilk, and at the same time it will bear more working without injuring the grain of the butter. Mr. Wales says that he has practiced reworking his butter several hours after salting it, which is correct, if he does not work it too much. He also says, that he reworks it for the purpose of removing the moisture. As he asks for information, I will say that butter is better to have crystal clear brine scattered all through it, and gives better satisfaction in market, and it will keep sweet longer than butter that has no brine in it; besides, if butter is worked in a dry condition, on until dry, it will have a much finer grain and be more or less salvy.

Adjourned.

April 25, 1871.

Nathan C. Ely, Esq., in the chair; Mr. John W. Chambers, Secretary.

Relieving Choked Cows.

Mr. P. Chelsea, Conn.—My brother saved the life of a valuable cow by cutting off four or five feet of three-quarter hose and using that to shove the potato down. Subsequently he used the same instrument repeatedly, once again for his own cow and three or four times for neighbors. In two instances a sharp-pointed iron rod was used in connection with the hose-pipe. Another man put a piece of rope inside the hose successfully.

Hoven from Green Clover.

Mr. B. Reaves, Marshall, Mo., lost two steers this spring. They were fed on corn till March 25th, and then turned out into a field of red clover. "After they had been on the field twelve or fifteen days, on the evening previous to their death they appeared to be unusually full and uneasy, and on the following morning found them dead. Now I wish to know if clover will kill cattle?"

Mr. R. J. Dodge.—A gas is formed in the creature's stomach.

Mr. T. C. Peters.—I never had trouble if I waited till dew was off, and salted the cattle before turning them out, mixing a handful of ashes with the salt. Others who do likewise will probably have similar escape.

Mr. Geo. Geddes.—We have all been troubled more or less by bloat in cattle. Stick a knife (a two-inch blade) just behind the last rib, and then put in a quill, or an alder with the pith punched out. I have done it often and it has never failed to relieve.

Mr. F. D. Curtis.—I have been informed that a liberal dose of ginger made into a ball and given to the animal will relieve at once.

It can do no harm, and I have faith that it cures. If it does, I certainly would try it before resorting to the knife.

Corn on the Worth Farm.

Mr. A. Wilson, Coatesville, Pa.—In this vicinity I cannot find any one who credits the yield of corn on the Worth farm. I have lived the most of my life in Brandywine, and know there are many farms equaling Mr. Worth's, if not so large, and you cannot find a man who will say he grew 110 bushels (fifty-six pounds) shelled corn to the acre. I have found that it takes four stalks to the hill, three and a half feet each way, and two large ears to the stalk to reach Dr. Trimble's statements. However rich the land, corn will not mature so thickly planted, ears being too much shaded.

Mr. Jabez Bailey, Marlboro, Chester county, Pa.—By the above statement, I find it will make 28,472 ears to the acre; which to make 110 bushels would require 258 ears to the bushel. Now as sixty large ears will make a bushel of shelled corn, 28,472 such ears will make 474 bushels, which to be produced from one acre is doubtful. If two large ears be produced by each hill instead of eight, he would have 118 bushels to the acre; so who doubts next? In the fall of 1868, sixty-eight ears of my corn, on taking the average, would make a shelled bushel, while fifty-two of the largest ears would weigh seventy-five pounds, equal to a bushel when shelled. As but few readers would make the calculation to see the absurdity of A. Wilson's statement, it ought to be corrected. My rule for ascertaining the number of shelled bushels a crib full of ears will make, is to divide the number of cubic feet in the crib by two and a half, which is nearly the same as James Fling's rule, and upon trial I find about right.

Mr. William Plocker, Fairwater, Wis.—Mr. A. Wilson says in relation to the Worth crop of corn, that in order to raise 110 bushels shelled corn, fifty-six pounds to the bushel, it takes four stalks to the hill, three and a half feet each way and two ears to the stalk, to reach Dr. Trimble's statement; that is, at three and a half feet makes nearly twenty-two hills per square rod. Eight ears to each hill is 176 or twenty-eight; 160 ears per acre, divided by 110 bushels, is 256 ears to the bushel, which, allowing seventy-five pounds to the bushel, is about four and a half ounces per ear with cob. If this is the weight of *large ears* of corn in Pennsylvania, it may be doubted whether 110 bushels can be raised to the acre; but I have just weighed four ears, fair sized seed ears, eight rowed Flint, two pound two ounces, average eight and a half ounces, and of yellow northern Dent two pounds ten ounces, average ten and a half ounces. I picked last October thirty-two ears Dent corn, which weighed forty pounds, and can find some now which will weigh fourteen ounces. And now about raising 100 bushels shelled corn per acre. I cleared off (spring, 1870) two and a quarter acres land on east line of section, described by United States surveyor as black oak land, third quality, having on it many large trees (many two feet in diameter), which were pulled over and out with stump machine, and the small trees were grubbed out; plowed with four horses, and planted 5th June. Season poor and cold; east half yellow Flint, west half yellow Dent. The Flint ripened, but the Dent was mostly soft; average yield estimated at about forty bushels, seventy-five pounds per bushel per acre. This land lays south of barn-yard, and stock had traveled through and over it for twenty years, inclines to the south, mellow clay, opening soil about two feet deep; below that stone and rock; leaches water faster than sand. All our land here is naturally underdrained; basins in which the water stand three and five feet deep when the ground is frozen, will discharge the water in twenty-four hours when the frost is out, and can be plowed and worked as soon as the high land round. Last spring fifty loads barn-yard manure of that winter were spread out on the place, and it was planted about 20th May, with one and a half bushels yellow Dent corn, drilled in four feet apart, single kernels, rows east and west. The sun by seven and eight o'clock in this latitude will shine down to the ground until four or five o'clock in the afternoon; whereas north and south when corn gets eight and ten feet high it does not reach down until nearly eleven o'clock, or only three hours per day. After planting, was well harrowed; also after it came up and was three and four inches high. It was dressed out with a two-horse wheat drill, center tooth out, three times, until three feet high. Our heavy rains and winds in June and July bent it over in the rows, so that nothing more was done to it; no hoeing, cultivating or plowing. If this piece could have been cultivated, plowed and hoed, the ears would have been much larger and better tipped out. It was husked on the hill last of October and fore part of November, when it was perfectly ripe and dry; and in market at Ripon or Berlin was bought by dealers at seventy cents per bushel. It was not offered for premium; but to be sure myself I measured it carefully with a chain, not from row to row, but two feet beyond all round. One man husked it all, scales on stone boat at side of field alongside of wagon, to be moved as the husking progressed. Every ear was weighed; result at seventy cents per bushel, average per acre for the two and a quarter acres, 87.32 bushels; one acre by itself, 96.20; and twenty six rows, about one-third of an acre, at the rate of 103.20. This I knew was best, and measured and had it weighed by itself; no guessing or estimating about it. About ten rows on the south were lighter, being shaded by thick woods; and on the north side about as many rows were poorer, on account of an old traveling road across it when in woods, to go to the back part of the farm, and owing to the dry time after planting and the straw clogging the planter (Emery's) there were many baulks, in one place seven rods in one row, vacant.

I intend soon to haul out about fifty loads more manure, and plant it again with more care, to have a full stand. And if your Club will give me as good season as last year, I will put up fifty dollars against a like sum by the Club, that the yield will be 250 to 300 bushels shelled corn on the piece of two and a quarter acres. And if any of the members of your Club doubt that 100 bushels shelled corn can be raised per acre, they can see it here with their eyes and believe, when they see the ground chained and every ear weighed before it leaves the field, allowing seventy-five pounds of ears to the bushel, which is enough for shrinkage, etc. We do not here measure any kind of grain, everything is weighed; corn is handled in the ear, seventy-five pounds early, when husked, seventy pounds when dry and from crib. The ground was plowed six or seven inches deep both seasons, and about two bushels of plaster were sprinkled on the piece, along the rows, when the corn came up.

Along the south side of the same section about twenty acres were broke in 1848. It has raised seventeen crops of wheat and two of oats for nineteen successive years, till 1868, when it was seeded to clover, and has the last two years yielded from three to four loads of hay per acre, besides fall feed. The first crop of oats in 1860, after eleven crops of spring wheat had been raised on it, yearly in succession, averaging over forty bushels per acre, grew six feet high, in many places as high as the horses' heads when reaping; and yielded (threshers' measure) eighty-six bushels per acre. The last crop of oats, in 1868, after six more crops of wheat yearly, yielded thirty-seven bushels per acre. Manured only once, in fall of 1859, when about fifteen loads were spread on it.

On Round Prairie, in this town, I was in a field of fifteen acres, in 1854, on which fourteen successive yearly crops of oats had been raised. They were considerably lodged that year, and had been every year; had yielded from sixty to 110 bushels per acre.

This cornfield lays in 43.40 north, where we are sure of a corn crop as in central Illinois, and someways north of Brandywine, Pa.

Again, in 1855, in an orchard not many rods from the above cornfield, to the north, I measured and weighed in the same way, two acres, including the apple trees, thirty-three feet apart, about eight years old. One acre yielded 86.40 bushels, and the other 77.20 bushels, seventy-two pounds per bushel. The last had a bad stony corner. This last piece had been cropped many years; never in grass, and had been manured some, but was not rich, and the trees took up some ground.

The name of this town is Metomen, so named in 1846, is the Winnebago for corn, sometimes Montemon, Metomonic, etc., from a crop of sod corn said to have yielded seventy bushels per acre, fourteen feet high, chopped in with axe on new breaking and no cultivation of any kind.

The Hon. George Geddes.—I don't think it a question of veracity at all, but the dispute arises over the terms employed to convey the meaning. Now what does Mr. Wilson mean by a bushel of corn, and what does John Worth mean by a bushel of corn? If a bushel of corn means two half bushels of dry shelled corn, struck measure, fit for the market, and if Mr. Wilson or any other man doubts that 110 such bushels grew on any acre of John Worth's, then I am with him. I doubt it too, and would not believe it on any testimony but that of my own eyes.

That corn was measured in the month of December, a few days after it was husked and cribbed. The surveyor measured the cribs, multiplied the length, breadth and depth, so as to ascertain the cubic feet of corn on the cob, and then multiplied by five and divided by twelve to get the shelled bushels. The accuracy of this computation depends on many circumstances that we know nothing about. Was the corn close packed in the crib? were the cobs large in proportion to the kernels? and above all, how much did it shrink before it was marketable? It probably shrank twenty per cent before it was fit to shell.

Dr. Isaac P. Trimble.—I never made any pretentions that it was other than corn freshly gathered. I am glad that Mr. Geddes puts the question in this light. I would like to know whether a cubic foot of ears is equal to five-twelfths of a bushel shelled. That John Worth or James Fling intended to deceive in the statement they made, I will believe when I see the Brandywine running up hill by their houses. The points I desired to make in that account of the Worth farm, was to show that with shallow plowing these worthy Quaker farmers could beat the world raising corn.

Rev. Joshua Weaver.—I don't understand that deep plowing of sod ground is best for corn anywhere. Corn is sustained by sod, and to this end keep it near the surface.

GREAT CROPS AND HOW THEY WERE RAISED.

Mr. D. S. Curliss, Harrisburg, Pa.—Some years ago I knew a farmer who adjoined me, that raised 101 bushels of shelled corn to the acre; that is, 303 bushels from three acres, getting the same yield two years in succession from the same field, and 500 bushels per acre of potatoes, for two successive crops, on same field. And this was the way he did it: The soil was a light sand, on a small ridge, twelve miles from Chicago. In the winter he spread a good thickness of fresh barn-yard manure all over it; then in April he plowed it under, with furrows about six inches deep, and gave it a thorough harrowing; then with a small plow he ran furrows about four inches deep, north and south, four feet apart, and marked across them, east and west, three feet apart; at the corners he put a light shovelful of well-rotted manure, and planted the corn, four kernels in the hill, and covered it well, about two inches deep, after soaking the seed six to eight hours in copperas water, and dried it in ashes or lime. When it was fairly up so as to show the rows, he put a small quantity of old leached ashes on each hill; carefully hoed it once, and thrice worked it with a cultivator, once each way of the hills, cleaning out all weeds. When it had a good growth, about two feet high, he went through it and carefully cut out all but two stalks to the hill, leaving the stoutest stalks; and what was cut out more than paid for the time in best kind of grain soil for his cows. From this treatment he harvested, as above, 100 bushels of good, sound corn to the acre, at about two-thirds of the cost of corn per bushel, where only sixty bushels to the acre were harvested. The second year, that is, soon after harvesting the crop, he again covered the ground with manure and plowed it under the same fall; then next spring plowed again, an inch or two deeper than the fall plowing; planted and treated the seed same as the first year, and obtained the same yield.

The two acres of potatoes were treated in the same manner, except not soaking the seed, but planting them in furrows, not hills, dropping two pieces every sixteen to eighteen inches apart in the furrows, and then covering them with the plow, by running it along and covering the furrow back over the seed. When they were dug with the same plow running a furrow under them.

ROTTING WOOD AS MANURE FOR VINES.

Bryan Tyson, Washington, D. C.—I am informed that in the vicinity of Cincinnati, Ohio, Catawba grapevines are being dug up by reason of blight, and that others of a more hardy nature are being substituted. Now, if the vines can be brought to feed upon some element of fertility during the period of their growth that will make the fruit healthier and more vigorous, it is believed that blight, mildew and kindred diseases will be prevented. In the vicinity of Wilmington, N. C., a gentleman, some fourteen years ago, set out in the usual way a Flowers grapevine, a variety of the Scuppernong. About four years thereafter he dug a pit two and a half feet deep, three feet wide, and ten feet long. He then filled this pit with green, round, red oak wood, six to eight inches in diameter, bark on, to within a few inches of the top, covered over with dirt, and planted a cutting from the vine that had been planted several years previously at one end of the pit. Last fall these two vines yielded jointly twenty-six bushels of grapes, of which the younger vine grew about two-thirds. Nor was this all; the grapes of the younger vine were larger and of much better quality than those grown on the parent vine. The vines were planted at one edge of the yard, and had received little or no culture since the time they were planted. The difference in yield must therefore be attributable to the wood buried as aforesaid. The philosophy of the above appears to be this: The oxygen in the air combining with the carbon in the decaying wood was converted into carbonic acid gas, which constitutes the principal food of plants. The principal advantage, then, to be derived from burying wood appears to be the formation of carbonic acid gas. Now, if a laboratory be constructed for generating this gas, by pitting as above set forth, the numerous little rootlets that will penetrate the sides of the pit will, it seems, draw therefrom a much more valuable element for sustenance than can be obtained from the soil in the usual way. I will also state that the capacity for generating carbonic acid gas can be further increased by burying with and between the logs vegetable matter, such as rank weeds. Animal matter, such as blood or unsalted flesh of any kind, will also answer a good purpose. During the period of decomposition, carbonic acid gas will be given off. If a hole be bored into one of the top logs, and a tube of an inch caliber be inserted so as to admit the air but not the dirt, the capacity for generating this gas will doubtless be still further increased, as an additional supply of oxygen can thus be obtained from the air to take the place of that in the pit as it is converted into carbonic acid. No fears need be entertained that the gas will ascend through the open tube into the air above; it is heavier than common air, and will sink to the bottom of the pit. The above discovery, like many of the most valuable inventions, appears to have been wholly accidental. It is believed that this plan would exert a beneficial influence upon every species of grape-vines, even where they have been set for several years. The subject is evidently worthy of further investigation.

Mr. T. C. Peters.—The same thing is done by every man who turns under a crop of clover.

Butter-making.

Mr. E. F. Dodge, Phelps, N. Y., asked various questions on this subject.

Mr. Geo. Geddes said the trouble is butter-making is an art which can't well be taught by tongue or pen, but must be learned by experience. However, he stated, in reply to a direct question, that as a general principle it is best to work the buttermilk out at once, apply salt, and give the butter a second working.

Trees Girdled by Mice.

Mr. H. H. Hart, Vischer's Ferry, N. Y., took exception to the statement of a member at the last meeting, who said it was no easy thing to make such trees live and thrive, and gave the following opposite experience: In the spring of 1852 I planted an orchard of about 100 apple trees. After the snow had disappeared in the spring of 1855, I discovered that about thirty of the trees had been badly eaten by mice, eight of which trees were gnawed all round for the space of from three to twelve inches. I used scions, inserted under the bark, above and below the wound, placing them about a half inch apart around the tree. The wounds have all disappeared; trees look healthy, and have produced fruit equal to those that received no injury. After watching the result for sixteen years, I would, if necessary, repeat the operation rather than mar the uniformity of an orchard by digging up and setting smaller in their places, grafting the stock, or waiting for sprouts to grow. The process does not require much skill. Any one who can whittle well can perform the operation, and what American can't?

Mr. O. H. M. Huester, Groveland, Mich.—My experience is that a tree so girdled, may not only have its life "prolonged," but it may be made as sound and vigorous as though no accident had happened to it; and this is my method: When the leaves of the girdled tree begin to open, and the bark parts freely from the wood, is the time to begin. Cut a number of scions, according to the size of the girdled tree, from two to four, or as many as eight. At each point you propose to bridge over, cut the rugged bark away, above and below, to that which is sound, and make a slight longitudinal incision in the bark, so that it will admit the scion without bruising its bark. It would be well to raise the points of the bark on each side of the incision. Now cut your scions to the proper length, allowing an inch and a half at each end to slip under the bark of the girdled tree; pare off the scion at each end, as far as it is to go under the bark, on one side only; now slip the scion down, flattened side next the tree-wood, under the bark, at the lower incision, and, by gently bending, shorten it back to allow it to be entered above. In this manner insert the requisite number, tie a string over each splice, to keep the bark from rolling up, and cover all the several splices with grafting wax, and your tree is sure to live and outgrow the accident, provided all is done with average skill and care. I have trees in my orchard that I repaired in this way four years ago, and now, except a slight enlargement at that point, one would never suspect that they had ever been girdled; in fact, I consider them just as sound as any other trees.

BONE-FLOUR.

Mr. C. S. Weld, Olamon, Me., was at the Club meeting over a year ago, and the Secretary gave him a two quart package of fine bone-dust. He took it home, and it enabled him to raise the biggest watermelons in all the State of Maine, and he took the first prize with them. He wonders whether it would show as remarkable effects on potatoes, and he has written to the Lister Brothers for a ton of it.

Mr. J. B. Lyman.—The fine bone-dust he received is a quick acting and effective fertilizer. I have come to the conclusion that it is better than all the guanos and strange chemicals in market. But the bone-meal he has ordered is not as fine as that in the little package, and he must not expect results quite so striking. It is a special fertilizer for corn, tomatoes and cabbages, and is the best top-dressing he can apply to his grass lands, whether the mowing lots or the old pastures. In such a cool climate as Maine, it is necessary to stimulate melons and get all possible growth out of them in July and the first half of

August. Nothing is so effective for this purpose and at the same time so cheap and harmless as fine bone-dust.

Farm Fences.

Mr. Charles R. Smith, Haverhill, N. H.—Fences are said to be the most costly production of American industry, out-running in expense the houses and barns of the whole country, including those of the cities. The plow, the planter, the seed-sower, the mowing and reaping machines would be of little use without fences to protect our crops. The safety of human life upon railroads, our cemeteries, and in some cases, even our forests require their protection. Even the legs of our fast horses, now so necessary to the success of our agricultural fairs, would come to a dead stand but for the security which fences give to our crops of grain and grass. Fences should be firm. They should be sufficient not only to stop all unruly animals, but to withstand the strong winds of the prairies. They should be straight, not having any zig-zag about them. New York loses 300,000 acres of her best lands by crooked fences! The folly of building three rods of fence when two would answer better, and the waste of material and land cannot be too strongly condemned. The best use which I have heard of having been made of the old snake fence, where land was valuable for cultivation, was to furnish fuel for the camp-fires of Union soldiers during the war of the rebellion. The cost of fences should always include the land they occupy. A farmer in Massachusetts boasted that he was the owner of over twenty miles of wall fence. If he will add to the cost of building the value of the fifty or sixty feet of land to every rod which the sun never shines upon, he will find that the divisions and sub-divisions of his fields with wall fences has been a costly way of getting rid of the rocks. Fences should not cost much more than the ordinary post and board fence, and should last at least thirty years. Their average duration is said to be ten years, and their annual cost to amount to $10,000,000 in the State of New York alone. Any improvement, therefore, which will lessen their cost or increase their durability would be of very great importance. Would it not be well for agricultural societies to discuss them, and offer liberal premiums for their improvement?

Do Varieties Decline.

Mr. R. H. Williams, said he took the liberty, for the purpose of eliciting the views of members, and, it may be, exciting inquiry outside the Club that shall lead to a more perfect knowledge of the facts that govern the reproduction of fruits from the seed, of asking this question: Is it practicable to reproduce the apple from the seed in its original kind? Or is it from inherent natural law that it does not do so, as we find in ordinary practice?

The almost universally entertained opinion that they will not, finds a strong contradiction in the following facts which came within my notice recently, and I therefore submit them for the consideration of this Club: In the fall of 1870, I visited what was once the home of Jemima Wilkensin, or as she was better known, "the universal friend," a religious leader who emigrated with her colonists from Rhode Island and Pennsylvania, and located on this farm, about one mile from the Seneca lake, and near the village of Dresden in Yates county, New York, now owned by Charles Townsend, Esq., of Torrey. It should be noted that this was the first permanent settlement by the white man west of the Seneca lake, and the first clearing was made in 1788, and thence on for years was the congregating focus of the friends' followers who preceded or followed her to this then wilderness country. This people brought with them seeds of every kind used, and among them those of the apple. One nursery, it appears, was sown wholly from the seeds of a variety known thereabouts as the "Friends' Slug Sweet." Thus brought, and kept separate from other orchards and apple trees by some considerable distance, and by intervening buildings, the trees of the nursery were set thickly into orchard immediately around the nursery grounds, and all allowed to grow as seedlings. There are yet standing over 100 trees in bearing condition of the old stock, and many younger trees that have grown up from the seed, all of which have a uniform shape, and are exactly identical in fruit, as are also all scattering trees grown in fence hedges and wood borders from the seeds of this apple carried and dropped by birds, as was shown by unquestionable testimony of those who have long known and observed the apple, and noted its reproductive tendencies. The fruit is a smallish sweet apple, shape somewhat conical, with but slight indentation at stem and eye; color yellowish ground, with a slight blush, rich in quality, and prized for its cider and cooking qualities, resembling the quince in the latter, and in the former it is said, that reduced by evaporation three to one, will keep any length of time. The facts and evidences in this case are briefly, that the apple was here reproduced from seed brought by the first settlers; that they sowed all of one kind in this nursery, and probably for its favorite qualities, and preserved it and the orchard from mixture. The result is, and always has been, that trees produced from the seed of this apple reproduced a tree and fruit identical with the original in every known case.

Query.—Will not any perfect seedling do the same if kept entirely separate from others, and may not pure seedlings be thus produced and perfected?

If so, does it not overturn the doctrine or theory, that seedling fruits will not reproduce their kind, and also establish the fact that the seeds from our variety orchards are hybridized, and therefore not pure. Is it not also a confirming fact, that the seed of the native or wild plum, apple, pear, orange and grape, and even some of the cultivated varieties of the peach reproduce their kind, where they grow free from contact with others by which they might become hybridized, and are universally so found?

This subject is worthy of consideration and experiment for if *pure seedlings* will reproduce their kind, then may we not perpetuate our most valuable varieties, that from only *continuation* as by budding and grafting are fast becoming extinct by loss of vitality from age, as all varieties must have originated from seedlings.

I have thus been particular in giving the history of this orchard, as probably there is not another similarly circumstanced and where so many facts are brought together that bear upon the subject in the whole country.

Mr. R. J. Dodge.—I have heard that most natural plants do reproduce themselves from seed, but cultivated varieties are apt to sport and change in various ways.

Mr. J. N. Crane.—The original apple was probably a wild crab. That remains, but grafted fruit seldom reproduces its like when the seed is planted. I never saw two natural trees whose fruit was alike, but grafted fruit of the same sort is the same. But this is all artificial. Let nature alone and she will go back to the crab.

Mr. J. W. Gregory.—We must not ignore the influence of climate and soil. These play a prominent part in vegetation. And Blakewell, during his experiments with sheep, found the same thing true in the animal kingdom.

Grafts and Varieties in Apples.

Nathan Shotwell, Concord, Mich.—A great difference in kinds of fruits exists in relation to their susceptibility of growth. For instance, the Greening throws up a short, crooked trunk. The Northern Spy is a straight, vigorous, upright grower. It is difficult for grafters to supply themselves with scions of some kinds in consequence of the tendency to slow growth. Ladies' Blush and Sweet Bow are specimens of this character, while Roxbury Russet, Baldwin, Greening are rapid growers. Scions grafted upon free, vigorous growers will throw up better growths and develop better fruit, both in color and flavor, than if grafted on stocks of puny growing kinds. Vastly more depends upon keeping the tree in a vigorous condition and well pruned for the admission of light and the circulation of air than all the influences exerted by the stock. Mr. Hathaway, in his address before the State Pomological Society of Michigan, as reported in the Michigan Farmer, claims that the Northern Spy, grown on the Greening stock, is much paler than that grown upon the Spitzenburg stock, standing in the same soil, and that the Rambo, grafted on the Pomme Gris, took the character of a Russet. I have no faith in such mixtures by the ordinary system of grafting. I believe the Russet, the Greening and the Baldwin, though grafted from time to time upon stocks of all varieties, and generally upon inferior kinds, are as perfect to-day as they were where they originated. The crab apple, though grafted upon the stock of the Twenty-ounce Pippin, will be the crab apple still.

FLORICULTURE.

The Chairman.—We are distributing a great many seeds this spring, and I wish we had the resources for distributing a million packages. He who sends out flower seeds and bulbs; he who fosters a pure and normal taste in the homesteads of this republic, is a patriot and a lover of the human kind. No man can daily walk down an avenue of roses, and marigolds, and asters, and amaranths, and portulaccas, and fuchsias, and geraniums, on his way to his work, or smell the breath of eglantine or jessamine blown in at his chamber window, and not become a milder, a better, a happier, and a wiser man. He loves his home better, and his children love it more, and he will advance from this refinement to others. To make homes lovely is to foster a love of them, and this breeds patriotism, and makes nations great or keeps them so. To give our country friends a hint toward adjusting the flowers to climate, and especially to soil, I have requested Mr. Peter Henderson to prepare three lists with a special view to such adaptation. He is well known as our most extensive cultivator of flowers under glass, and his book on floriculture is an excellent practical guide.

First. List of annuals suited to rather poor ground and earth thrown up from cellars:

Adonis Autumnalis,
Bartonia Aurea,
Candytuft,
Clarkia,
Collinsia,
Gilia Tricolor,
Mignonette,
Nemophila,
Nolana Lanceolata,
Nasturtiums,
Nigella,
Lupins,
Prince's Feather,
Morning Glory,
Antirrhinum, or Snapdragon,
Amaranthus Tricolor,
Sweet Alyssum.

Second. Flowers that will grow well on prairie when first opened:

Asters,
Calliopsis,
Callirhoe,
Cape Marigold,
Campanulas,
Cypress Vine,
Delphinium,
Eschscholtzia Californica (Californian Poppy),
Evening Primrose,
Leptosiphon,
Limnanthes Douglasii,
Linum Grandiflorum,
Musk Plant,
Palafoxia,
Samitalia,
Sweet Sultan,
Sweet William.

Third. List for the average village door yard in the latitude of New York:

Amaranthus,
Cacalia, or Tassel Flower,
Clarkia,
Catchfly,
Chrysanthemum (annual),
Dianthus, in variety,
Ipomeas,
Marvel of Peru,
Pansy,
Peturnia,
Phlox Drummondii,
Portulaca,
Saponaria,
Scabiosa,
Sweet Peas,
Venus' Looking-glass,
Virginian Stock,
Viscaria,
Whitlaria,
Zinnia Elegans.

How Land is Irrigated.

Mr. D. S. Hall, Bergen, Hudson County, N. J.—I am desirous of understanding the details of how land is irrigated in the best manner.

Mr. J. B. Lyman.—The best instances I had the pleasure of studying last summer were at Salt Lake among the Mormons in California, and at Greeley. Plan the main ditch so the fall will be moderate all the way, and run four big furrows, the last two under the first, and all throwing the dirt down hill. Now throw out all that loose dirt, and it makes a bank on the lower side. This is the main. The sub-ditches come out from the main at intervals of about forty rods, according to fall, and from these little streams lead out like teeth on a coarse comb. In hot, dry weather, the water is let on once or twice a week, and wets the land for about two hours, and then is shut off. The evening is the best time for irrigating. When the supply of water is ample, it makes the prettiest agriculture in the world. At Salt Lake and Greeley they never look at the sky. It makes no difference whether it rains or not. They ask no odds ot theweather clerk.

A little dam pushed up with the foot will take the water from an acre, and one stroke of a hoe or spade will let it on again. There is no accessible book on the subject.. Common sense and one year's experience will guide him.

Adjourned.

PROCEEDINGS

OF THE

POLYTECHNIC ASSOCIATION.

The Polytechnic branch of the American Institute held a regular meeting on Thursday evening, May 12, 1870; Samuel D. Tillman, LL.D., occupied the chair, and Robert Weir, Esq., acted as Secretary.

MALARIA.

Professor J. Darby took up the subject on which he had read a paper lately, before the Association (see Transactions of the American Institute, 1869–70, pages 1021–1032, inclusive). He said the subject was of great importance, and he desired to present some points not included in his first paper. Personally he had no other interest in the question than that which concerns every one. He had paid especial attention to the subject of malaria, and nothing more; he had no theory to battle for; his object was simply to state certain facts he had gathered from experience. A great deal had been written and said on the subject, and the examination of official reports regarding the cause of death will throw some light on it. In the city of New York, according to the report of the board of health, 7,454 persons died of zymotic diseases during the last year; that is, they died of poison, and their lives might have been saved had a proper course been taken to protect them from the poison. There are no more reasons why the people should be protected from fire than from malaria. A fire sometimes gets the upper hand of us, and malaria at times does the same; yet both can be guarded against, and now every death from zymotic disease is a blot on the age in which we live. In the summer quarter of 1868 there were 3,870 deaths, or a little more than half of the number for the whole year. If, during the whole year, deaths had occurred from this cause at the same rate as during the summer, the whole number would have been more than 15,000, instead of 7,454; so we find that cold weather effects a saving of more than 7,000 lives per annum. The methods of investigating this subject are often not the best adapted to provide the best remedies. We do not need any better agents to destroy malaria than those which nature uses to do this work. The air generally, vegetation, ozone, and running water are the means she employs for this purpose. Since he last addressed them Dr. Vanderweyde had spoken on the same subject, and during his remarks exhibited a microscope, but for what purpose he could not see. There is no instrument so deceptive as the microscope, in making investigations as to the cause of malaria. But there was one point which the speaker thought Dr. Vanderweyde did not understand. He had stated that malaria was generated in the absence of sunlight, at three or four feet from the ground, and that this material was much finer than a cobweb.

Dr. P. H. Vanderweyde begged to explain: It was only the malaria that produced the fever and ague that was so spoken of by him. Dr. Stegallia, who investigated the malaria of the Pontine marshes, near Rome, so described it.

Prof. Darby continued: At a late meeting of the cheese-mongers of London, it was stated by a member that an organic cell produced by the monad was a light colored liquid with dark colored inequalities; and that one cell contained 130,408,000,000 of animals which know no other office than to make the curd. He doubted this very much. He ventured to assert that no man ever saw such a vehicle. He, himself, had been deceived by the microscope. He stated, when lecturing to a college class, years ago, that the time would come when the blood discs in human blood would be found to be real animals. The Bible account is that the life is in the blood, but there is no telling to what investigations with the microscope will lead. If the liquor of an oyster is left standing in the shell, dark and yellow specks will be formed, which fall to the bottom; bubbles will also be formed, but when examined by the microscope no germ plants are detected. There are other facts in this connection which might be stated, but time does not permit. Let us notice the direction which the investigation of this subject has taken. Mr. Styles of this city has published a report on this topic. The means he has taken were not the best that could be chosen, but here are the results: Mr. Styles has found in the air of the public schools $\frac{8}{1000}$ and in the Bowery theater $\frac{7}{1000}$ of carbonic acid in a given volume of air. Carbonic acid is set down in the books as a poison, yet we may place an animal in air containing one per cent of carbonic acid and no ill effects are detected, except in the case of a bird, on which it acts differently. Dr. Angus Smith, our highest authority, says that the unpleasant feelings which comes over us in a crowded room is not owing to a want of oxygen in the air, as there is but little difference between it and the external air. He ascribes this feeling to the presence of organic matter in the air, which is thrown off from the human bodies present. It was these emanations of the body which caused such dreadful havoc in the Black Hole of Calcutta. If linen, worn for some time, be exposed to the heat of a fire, the stench arising from it is almost unbearable. This kind of matter is found in the atmosphere. The experiment made by the speaker at a previous meeting showed how easily we can test the purity of the air. The moment any of this matter comes in contact with permanganate of potash, its nature is revealed almost instantly. There are other substances that will change this permanganate, besides malaria. Hydrogen will do it, but we can remedy this by putting in a substance that will abstract this material; for instance, the iodide of starch. So, with this precaution, we can safely say that whenever permanganate of potash is changed there is evidence of the presence of malaria; and we might use the ozone test without affecting this malaria. At the city of New Orleans he had detected malaria near the ground and ozone at the top of the house. He could tell, when in that city, when the cause of the yellow fever was approaching, and he had met residents of that city who assured him they could detect its approach in the night, while they were in bed, by its peculiar odor. While riding in marshy regions at the south, he could, himself, tell within a foot of the line where his horse came into malarious air. It could be detected as readily as if he had stepped into water. It had been said that the greatest enemy to health is our own breath, but he believed emanations from the human body were far more pernicious. When a person is taken sick and confined to the bed, he is kept in the presence of these emanations. In many cases, simple change of bed clothes and change of air would overcome the trouble. Much of the characteristic sickness in the southern States could be remedied by vegetation. After a year's residence on the Mississippi bottom lands, he became convinced he could make a safe place to live, even there. If there is proper vegetation in such places, there is no danger.

In 1856, he was at Altoona, Pa., and noticed the Lespedeza plant there, of which he now exhibited a specimen. He carried it home, and named it as a new species of Lespedeza. During the next summer he was at Columbus, and found the same plant. The next year it covered thousands of acres, and in three years it spread over nearly the whole country. It is a long, straight plant, which keeps green until the frost comes, so whenever vegetation is required to protect against malaria, it may be found it this plant. It is often a wonder why we have malarious fever in the fall. It is simply because vegetation has died out.

We get malaria at the ground, and ozone at the top of trees. Persons having dysentery, typhoid fever, etc., should have no ammonia around them in the sick-room. Ammonia will destroy every trace of ozone in the atmosphere of a room. Spirits of turpentine, if exposed to the light, will generate ozone. It has been said that malaria will never be produced below 53° F., but the converse of this is that ozone will not act below 53°. In attempting to produce the effects of ozone on a cold, frosty morning, he failed; but in the middle of the day it acted as desired. If the temperature is so low that malaria will not act, we will find, at the same time, no ozone.

The subject of embryology, which Dr. Vanderweyde introduced in his remarks on malaria, at a previous meeting, do not seem to me to have any bearing on this question, as there is not the slightest evidence that parasites produce the same effect as malaria. They doubtless cause diseases of the skin, but such diseases have no analogy to those produced by the action of malaria. In one case, the disease cannot be eradicated until these parasites are destroyed; in the other, the disease is conquered when the body is brought into good condition by tonics, but in most cases no medicine is required. With pure air and cleanliness, the body will throw off the disease. The speaker claimed that the facts which he had observed confirm the chemical rather than the parasite or germ theory of the origin of malarious diseases. The germs which cause these diseases are not living organisms, but particles or molecules of decomposing organic matter. This matter is poisonous in its nature, and consequently capable of producing disease.

Among the most efficacious means of preventing the action and accumulation of these sources of disease is the presence of ozone, which is frequently found at a considerable height in the atmosphere, while malaria is doing its deadly work below. In dwellings immunity may, therefore, be obtained by the use of machinery to force ozonized air downward from a considerable height into the rooms, basements, etc., liable to the presence of nuisable vapors or emanations.

Dr. Vanderweyde replied briefly with reference to the nature of the malarial matter, supporting the view that it is constituted by microscopic organisms, and acts by inducing a species of fermentation similar to that involved in the growth of the well known yeast plant. The accepted tests for determining the presence of organic matter in the air by the decolorization of permanganate of potash, are not to be wholly relied upon, because other substances give a similar appearance, and consequently great care and skill are required to secure results upon which dependence can be placed.

Modes of Testing Steam Engines.

The next regular subject for the evening, "The Different Modes of Testing the Power of Steam Engines," was then taken up by Dr. Vanderweyde. Animals, he said, had been compared to steam engines; but the comparison would hardly hold good. They were far more economical that the best engine; more compact; a better machine, in fact. In a steam engine, people were not likely to look upon the first cost, nor upon the attendance it was likely to require; and they were perfectly right in this. It is not probable that the latter can be decreased, and the former is subordinate to many other points.

The main points upon which economy depends were then stated. The chief of these are the engine and the boiler. These are two very different things, and can be judged separately. The scale for this judgment is the foot-pound. In the first days of the steam engine, it was found that the actual and theoretical power of an engine were widely different. The difference was enormous, and for want of a better reason, was set down against "frictions," till at last it was suggested that the steam was reduced in pressure before the receding piston, and this variable pressure must be made the basis of the calculation. In order to do this, the indicator of Watt must be used. The cut-off was an attempt to economize steam by using all its elasticity.

The Chairman here remarked that the indicator was an invention of a young man employed in James Watt's office, and that Watt saw its advantages, and brought it into use. These facts are well substantiated. Watt had made the differences between the nominal and actual horse-power a study, and was very quick to see the advantages of the invention.

Dr. Vanderweyde resumed: The results obtained from the indicator may be proved by the dynamometer, which measures the exact force with which the engine turns a shaft or drives a wheel. Their results correspond, for the indicator shows less steam used when the engine is running light than when working up to its full power.

Another way of estimating the amount of work performed, is by measuring the steam consumed. Experiments in this line had been performed at the Brooklyn navy yard, in pumping at the dry-dock, where every facility for doing it existed. The steam was measured, and the amount of work done by it in pumping accurately known; and it was found that the engines were much more economical than the boilers. It is best, in estimating power, to separate the engine and boiler. The best way to do this is to measure the amount of heat consumed in the engine, and the amount wasted in the water, of condensation. This gives us the best of all methods in getting at the exact amount of work performed by the engine. The rule is, to multiply the number of pounds of water by the number of degrees to which it is heated in the act of condensation, and that gives the number of units of heat lost by the engine. For example, if the number of units of heat thus found is 24,000, and the horse-power is sixty, then the loss per horse-power is 400, and it is a curious fact that this loss per horse-power is constant in each engine, no matter what amount of power is being developed at the time. By the use of the self-registering thermometer, the exact loss and work of the engine may be ascertained for the whole day, or at any given time in the day.

As the engine may be considered simply as a system of mechanism for changing heat into motion, economy of fuel is the point most to be considered in any estimate of the utility or working value of a given engine; the questions of first cost and expense of attendance being of comparatively minor consequence. The quantity of fuel required to produce a stated power depends upon the construction of the engine itself, upon the character of the boiler and its furnace, and, lastly, upon the skill exercised in firing. In estimating the horse-power of an engine, the old plan of multiplying the number of square inches of piston surface by the pressure in pounds per inch in the boiler, and dividing the product by 33,000, should be ignored, it having been proved fallacious nearly half a century ago. Instead of the steam pressure in the boiler, the steam pressure in the cylinder when the piston is in motion must be taken as the multiplier of the piston area. De Pambour, many years since, in France, demonstrated that the pressure of steam on the moving piston is frequently only a quarter as much as the boiler pressure. This diminution of pressure in the cylinder, as compared with that in the steam generator, is due partly to bends and impediments in the steam passages, and partly to radiation from the cylinder surface, but in the main to the fact that the steam, having to follow the piston, is not able to exert its full pressure. From this arises the utility of the indicator showing the steam pressure at all portions of the stroke. For judging a steam engine without regard to the kind of boiler used with it, the weight of steam has, until very recently, furnished the most practical test, although priming, etc., always makes the apparent evaporation greater than that which really takes place. For trials made on this system, Dr. Vanderweyde gave the following as the rules imperative to be observed, if anything approaching reliable results are to be obtained by this method:

"1st. The water to be measured in tanks, and not by water meters, which are always unreliable. 2d. No steam to be used from the boiler during the trial, for other purposes than for the engine to be tested. 3d. To let the engine perform a constant, well-determined amount of labor during the trial. 4th. The amount of water in the boilers at the end of the experiment should be exactly the same as in the beginning. 5th. When the boilers have blown off salt or muddy water during the trial, this amount should be ascertained. 6th. The experiments should be very carefully and skillfully performed and often repeated, in order to eliminate incidental inaccuracies caused by temperature of the air, variation of water-level, etc."

The objections to the above method, familiar to engineers, may be obviated by a more truly scientific one, which consists in recording the units of heat carried off by the exhaust steam. By simply providing a condensing engine for any specific time with a definite quantity of water as a condensing agent, and noting, by means of a thermometer, the degrees of heat communicated to it by the condensation of the steam, the quantity of heat carried off by the exhaust may be found by a simple calculation. This has very much facilitated the accurate testing of different rates of expansion, etc. The units of heat thus carried off in the exhaust are, of course, so much abstracted from the force employed to drive the piston, and the less this quantity of heat, other conditions being equal, the more efficient the engine for a given expenditure of fuel. The mode of applying the test is very simple, it being only necessary to place one thermometer in the inlet of water to the condenser and the other at the outlet of the latter. By noting the difference in the temperatures indicated by the two, it remains only to know the quantity of water passed through the condenser per minute, and the results may be readily computed. In testing high pressure or non-condensing engines, the same principle is applied, but in a somewhat different manner, the exhaust steam being turned into water in a tank of known capacity, so that the rise in temperature for a given time furnishes, as in the previous instance, the required data of the heat carried from the engine by the exhaust.

Adjourned.

May 19, 1870.

Professor S. D. TILLMAN in the chair; ROBERT WEIR, Esq., Secretary.

BOILER SCALE AND SURFACE CONDENSERS.

The chairman presented a very large specimen of scale, weighing over 100 pounds, from the boiler of the steamship "Ocean Queen," sent to the Association by W. W. Vanderbilt, with the following letter relating chiefly to surface condensers:

NEW YORK, *May* 13, 1870.

Professor S. D. TILLMAN:

Dear Sir.—Please accept this specimen of scale, sent you by express. It is a specimen taken from the boiler of the steamer "Ocean Queen," and is only about one-half its original size, in consequence of being broken on its removal from the boilers.

In order to set at rest the inquiry how so large a piece of scale could be got out of the boilers, I will say that the boilers were old, and were taken out of the ship and put on the dock, making room for a new set of boilers in their place. In cutting up the old boilers for removal to the iron yard, I discovered this large amount of deposit, and had it as carefully removed as possible; this will account for the specimen being larger than could be gotten out of the man-hole.

Now, it must be taken into consideration that the engine of this ship had what is known as a "Pirsson condenser," which was supposed to furnish three-quarters of the water necessary for the supply of the boilers with fresh water. In my opinion, this style of condenser completely fails to do, and has been generally abandoned by the merchant marine.

It will be noticed that the specimen is not one solid mass, but is probably an accumulation of years, the old boilers having been in use about ten years when taken out of the ship. Much allowance must be made for the conduct of the engineer of the ship, who really had not sufficient time and help to thoroughly cleanse his boilers while in port, owing to the mistaken economy of the owners. Had the engine and boilers of the vessel been connected with the present type of surface condensers, and kept in proper order, no such sediment could possibly have been collected. All the ships of the Pacific Mail Steamship Company have the so-called "Sewell condenser," but the late Mr. Sewell never claimed anything but the manner of packing the end of the tube, and his method of packing has been completely superseded by Mr. Horatio Allen's compressed wooden packing, obviating entirely the necessity of followers, etc., for securing the packing. They work to admiration in the above mentioned steamer. These steamers produce a horse-power in their every day work with 2.8 pounds of coal per hour. This is beyond doubt, as I gave all the data of logs, etc., to Mr. Isherwood, and have his own record for the fact.

Of course part of this is due to the peculiar type of engine (American vertical beam); a part, no doubt, to model and shape, peculiar build, boilers, and much to a happy combination of all; but much is due to the condenser. At least twenty-five per cent is saved by a surface condenser, such as these ships have. I think owners of steamships stand very much in their own light when, contracting for new steamers, they do not stipulate for surface condensers. There is also fully twenty-five per cent saved in a few years (or, say the life time of a set of boilers) in the repairs of such boilers. With this kind of surface condenser a better vacuum can be obtained than with the jet condenser. I can certify to a vacuum expressed by twenty-nine inches with a syphon mercury gauge. Objections have been raised to surface candensers on account of galvanic action. I do not hesitate to say this objection is very much over-rated. With the proper precautions, such as using cast iron feed pipes, and copper bends and tinned tubes, I have not experienced any trouble whatever. Much greater trouble to us has arisen from the imperfect manufacture of the tubes and other parts of our boilers.

Owing to the economy of space, tubular boilers are mostly used in steamers now, and to these, with the surface condensers properly made, no objection can well be raised. I would recommend the use of surface condensers even in vessels running on fresh water rivers. My reasons are, simply, that the use of pure water in the boilers makes them much more durable, and consequently more economical.

A proportionate increase of speed is doubtless due to the difference in vacuum made in the ordinary jet condenser and in a closed or surface condenser; the one injecting air constantly while in use; the other injecting no air except what enters by leakage. I sincerely hope the engineers of the Polytechnic will thoroughly investigate this matter, and correct me if I am wrong.

I remain, most respectfully, yours,
W. W. VANDERBILT,
569 *Broadway.*

After some discussion on the subject of surface condensers for steamships, the next topic introduced was

Ice Machines.

Dr. Vanderweyde then gave some information upon ice-making machines. The ammonia machines are very expensive, and there are some very grave objections to their use. When the cooling water reaches the temperature of 80° or 90° they will not work well, owing to the great pressure. It is necessary, therefore, to store in an ice house the ice made in the cooler portions of the year. This is the plan they have adopted with the ammonia machines in New Orleans. The ice machine built by the speaker at Patterson, N. J., obviates all these difficulties. In this machine, one of the lighter products from coal oil is used, a liquid called chymogene. Its gravity is 106° to 108° Beaumé. Its boiling point is 26° to 28° Fahrenheit. An abundance of this liquid or gas (for it is a gas at ordinary temperature) is obtained as a waste product in the purification of the coal oils; and it escapes from many of the oil wells in vast quantities. Some of its advantages are, that it takes up a great amount of heat, produces a greater degree of cold than ether, and, at the same time, the vapor is very dense, being some six times heavier than air, while the ammonia vapor is lighter than air. The experiments and calculations that were necessary for making a machine that should produce a given amount of ice in a day were then narrated at length, and conclusively showed the value of theoretical knowledge. The trial of the machine took place last week. Owing to accidents, it was late in the evening when the machine was well at work, and Dr. Vanderweyde, after watching the thermometer for about an hour, made a little calculation as to the amount of heat the machine was capable of extracting, and, finding the machine was doing work sufficient to produce the requisite amount of ice, said he was satisfied, and left the place, while those in charge of the machine, not being so strong of faith in the theory, kept on with the work, and three hours later had proved by experiment that the machine could produce ten tons of ice per day, having done a proportionate part of it in an hour. In answer to questions, the doctor said that the freezers were in the liquid chymogene, which he had formed, and which was colder than the vapor, as it expands 300 times in becoming vapor. He made the pipe for the vapor five inches in diameter, while the tube which conducts the liquid back is only three-quarters of an inch.

COMPOUND STEAM ENGINES.

By J. K. Fisher.

I propose to treat of the class of engines that is now superseding the old class in ocean steamers, and beginning to prevail in stationary service.

Twenty-seven years ago, I submitted to the Navy Department a plan of engines and boilers for a steam-frigate. As to the engine, it was the same that now is coming into use; and as to the boiler, it was in one important particular the same that has been attempted many times by the most eminent English engineers, and recently with encouraging results. The engines were "high and low pressure," that is, the steam was used first in a high-pressure cylinder, and exhausted into a large chamber, from which it was taken into a low-pressure cylinder, and exhausted into a surface condenser. The boiler was made up of water-tubes, which would bear thousands of pounds pressure, and probably fail by leakage long before they would be so weakened by rust as to be in danger of bursting; and, if purposely bursted, could not, instantly, liberate power enough to destroy or seriously damage a ship.

This design was first suggested by Woolf, and improved by Perkins; but I modified it, by combining with it the approved details of the condensing engine, which Perkins had neglected, or endeavored to supersede by inventions of his own. The design, as I submitted it, was essentially what is now in use; and had the department adopted it, and caused it to be built by the best engineers of the time, it would have placed American marine engineering very nearly in the position now occupied by the English.

The chief difference between my plan and the one now adopted is in the intermediate chamber. This plan has been tried in England, and has not prevailed; it has been deemed better to exhaust directly, through the shortest ways possible, from the high-pressure into the low-pressure cylinder. A considerable saving results from this arrangement; which avoids the loss caused by the outburst, or unresisted expansion of steam, when it is released from the high-pressure cylinder, but I believe this saving will not pay the cost of the additional cylinders which the English use; at least, it will not pay where interest is high and construction very costly, as they are here; though it may pay in England, where the interest due to the two additional cylinders would be a third of what we should have to pay.

The leading establishment in furnishing this kind of engine was that of Randolph & Elder. They had, some time ago, built seventy-five sets for screw steamers. Other builders followed, as they were called upon; and now most are engaged in building them; and the majority of screw-ship engines being built are of this class.

Elder, who was the man that led, tried earnestly to produce a good high-pressure boiler of the safe class, made up of tubes; but he failed to produce one that could make steam fast, and was constrained to work at a low pressure of about forty pounds; and most others use about this pressure. But A. M. Perkins & Son have recently fitted a river tug-boat with compound engines and a water-tube boiler, with 280 lbs. pressure. The boiler was proved at 3,000 lbs. There is no leakage from boiler or engine, and all works well so far as appears; but no tests of economy of fuel have yet been reported. Elder tried about 300 lbs.; and others have tried about equal pressures; and it seems to have been proved, that, so far as it affects the engines, there is no serious difficulty in this or in a much higher pressure. The difficulty is in the boiler, or, rather, in the furnace and flues. Elder, in a lecture, not long before his death, said that, in a tubular boiler which he built, "eighty feet of surface per horse power gave excellent results." But eighty feet is intolerably excessive, worse than the Cornish pumping boilers, which require seventy-five feet to yield their great duty, and so much surface is utterly inadmissible in ships. The multiflue boiler yields better results with less than a third of the surface; and, were it safe, there would be little need to experiment further with water-tube boilers. But it is not safe; and persistence in its use in passenger ships ought to be punished by the abhorrence of all intelligent men. What became of the steamers we have never heard from? The greatest probability is that their boilers suddenly destroyed them, as the *Pulaski* was destroyed, and would not have been heard from had she not been near the coast, where there were many small vessels constantly sailing.

Without occupying time which cannot be spared to discuss this point, I assume that we must have boilers which, if purposely bursted to show the utmost harm they can do, will not break down a partition, or even burst open a furnace door, or fill a boiler room with steam, or in any way kill a man employed in the ship, much less a passenger. I am confident that we can make such boilers; and though I am only an amateur engineer, I can look back upon my past plans and opinions, which, in their time, were rejected, but are now established by others, and see in them a warrant for confiding in my own judgment in these matters.

I do not boast as if all that I have advocated had been invented by myself, or even as if I had perceived the merit of it without help. On the contrary, I am bound to acknowledge that, for most of what I believed, while professional engineers disbelieved it, I am indebted to others, most of all to that great genius, Jacob Perkins, whom I was acquainted with for six years, and often met, and whose ideas I accepted with only such scrutiny as amateurs usually give to such subjects; but these ideas I afterward carefully examined, and was confirmed in them fifteen years before they were practically established.

Nor do I intend to disparage the engineering profession beyond the degree which the leading members of that profession now confess to be just. Like all other professions, it cannot claim exemption from timidity, slowness of perception and bigoted reliance on custom, and universal, rather than general, distrust of inventors who have not studied in their own schools and shops. Like others, they unconsciously assume that all new ideas must originate from themselves; that, outside of their inclosure, there is no genius for their pursuit. And, individually, engineers, like others, tend to particular branches and partial views; one is convinced that low pressure is best, and easily — and correctly, if his first position were correct — concludes that surface condensation does not save its cost; another neglects condensation; and there are few who clearly see all the elements, and properly proportion and combine them, and develop plans that will not fail at either end or side. And when a ship-owner consults several engineers about a new plan, he is informed by one that this part of it has been tried and abandoned; by another, that another part has been tried and abandoned; and so on through all parts. And all with perfect truth, so far as disconnected truth can be perfect. Therefore he concludes that his money will be safer if applied by these specialty experts than it can be if applied by the rash inexpert who dares to meddle with all parts of a subject. And thus old errors are kept up and defended, and improvements are postponed.

This kind of reasoning has kept back this kind of engine for fifty years, nearly. It had been proved that Woolf's engine had no advantage over Watt's; that is, there was no advantage in two cylinders to pay the additional cost, in the way then adopted. Afterward, it was proved that Hall's surface condenser did not pay for itself when the pressure was 3½ pounds above the atmosphere. And water-tube boilers would fur up and not steam fast with little fuel. And it was imagined that there was an insurmountable difficulty in making heat pass into a tube as well as out of it. But there has not been, until recently, a liberal and judicious trial to find whether these elements, which are of doubtful use separately, would not be useful to each other when combined. But, thanks to the genius of Jacob Perkins, and to the faith and perhaps partiality of his son and grandson, we have now a prospect of a trial of high pressure with its proper accompaniments.

It should be added that the reasonable fears of travelers have much retarded the use of high pressure. But, in spite of these fears, the pressure has crept up, until it is now sufficient to rend ships into several parts, and sink them before their boats can be got into use.

The key to this system, not yet found, perhaps, is a good water-tube boiler. I confess my doubt whether, with the best safe boiler we have, we can carry passengers as cheaply as they can be carried by those who risk their lives. If passengers were property, valued at $1,000 each, and insured, I think the new system would pay best. If governments were wise and strong enough to compel the insurance of all passengers, at the rate now adopted on the railways of this State, $5,000, they would very soon cause the adoption of perfectly safe boilers. And I would gladly sign a petition for an act to impose such a condition on all internal and coastwise travel, provided that it should apply to all modes of travel, so as not to give advantage to modes exempt from it. But to return. Though I doubt, I by no means despair, but rather hope that we may be able, without further invention, if that be impossible, to make absolutely safe boilers as economical as the best multiflue boilers.

I need not now say more of this system, which consists of high pressure, 300 lbs. or over; of surface condensation; and of two or more cylinders, with the steam going successively through all of them. Not more in explanation; but I must reply to certain objections that have been made, inconsiderately I believe, to high pressure as it affects the engine.

First. It is objected that the side-valve will be abraded under such pressures. I think we have abundance of negative and some positive evidence against this notion. We have had considerable experience with pressures over 200 lbs., and some of 240 to 300; and no extraordinary abrasion has been observed under it. On the other side, we have had, under low pressures, in some of our naval engines, such abrasion as soon disabled them, and rendered it absolutely necessary to balance the valves, or relieve them by rollers. I have never heard of much trouble with the valves on the Erie railway, under pressures of 140 lbs. and often more, although I have been much acquainted with those who had charge of the engines and repairs; yet from several credible sources I have heard of such troubles in the naval engines, as I have stated. And in England the evidence is to the like effect; they use balanced valves generally in their marine engines, and in locomotives they have not used them until within a few years. The balanced valves are liable to loss by leakage, as was well known, and would not have been used in marine engines more than in locomotives had there not been more need of them. More might be said from experience, but this must suffice for the short time. As to theoretical reasons, it is obvious that, for a given proportional back pressure, the power to work slide-valves diminishes as the pressure increases, because the load on the valve remains constant, and the travel decreases with the diameter of the piston, the length of the stroke being the same. For example, compare a marine screw engine of two feet stroke and thirty-six inches bore with a locomotive of two feet by eighteen inches, the pressures being in inverse proportion to the areas of the pistons, say forty pounds above the vacuum in the marine, and 160 pounds above the atmosphere in the locomotive. Suppose them to work at equal speed of piston. To get the same proportional back pressure, there must be the same proportion between the area of piston and steam-port, hence the valve must be proportioned to the piston, that is, it must be twice as wide and twice as long for the low pressure, therfore its area must be quadrupled, while the pressure on each inch of it is quartered, the total pressure, therefore, being equal to the total pressure on the locomotive valve, but the travel, to open the ports, must be double, therefore, the total resistance is double. Now, by the principles discovered by Joule, Meyer, Regnault, and others, the power exerted is an index of the heat produced by the friction, and the heat is proportional to the wear or abrasion, or cutting, as it is called, or it is nearly so, some allowance being made for the diffusion of the heat over greater surface. To this it may be objected that the friction is not in all cases proportional to the pressure; but Morin and most other experimenters have agreed that the friction is proportional to the pressure within the limits that pertain to this question. But in practice we should increase the surface for high pressure, we should give more side lap, yet on the whole we should lessen the valve friction and the wear.

Second. It is objected that the cylinders will be abraded by the pistons, at the high temperatures, for want of water to lubricate them. It is a mere supposition that there is water, or a "film of dew," between the piston and cylinder, in ordinary engines, during any part of the stroke. Whatever water in any form there may be on the surface at the end of the stroke, is probably vaporized before the piston has gone far on its return; and the surfaces are practically dry; and observation on locomotives generally, fails to detect any traces of water in the cylinders while running. And were there water, it would do more harm than good; for cast-iron on cast-iron working dry, has less friction than when wet with water, according to Morin's experiments. And we have had much experience with cylinders in smoke-boxes, and steam-jackets, and flues around them to keep them hot, and with superheated steam; and rarely, if ever, have the cylinders lost their usual polish, or worn sensibly faster than usual. The objection is, therefore, unproven, as objections usually are; it seems as if the uppermost notions of possibility might be put forth as objections, without the slightest proof from experience, or even from theory; but it is time to dismiss such fancies.

Third. It is admitted, by experts, that there will be leakages if the boilers and engines be not well made; but we have sufficient proof that good tools and good workmen will not fail to make all tight under 300 pounds, and that without excessive friction; and, so far as practice has yet gone, it has shown that the friction of pistons and rods, as well as valves, is less in proportion as the pressure is higher.

Jacob Perkins for a long time worked a shop engine at 1,500 pounds pressure. Alban worked at 1,000 pounds, without other trouble than the rapid waste of his hemp packings. Fairbairn has recorded his belief that 500 pounds will be found better than a lower pressure. And we have had much experience at 240 to 300 pounds in steam carriages. All this warrants a trial, on a large scale, of 300 pounds, which is what is now proposed by many for screw steamers.

Here is a boiler (on paper) which I designed many years ago, soon after Howard published his. It is founded on the invention of Macerone, who patented, in 1833, a steam-carriage boiler, which Gordon deemed the best of the steam-carriage boilers. It seems not to have made steam more than two-thirds as fast as an upright multiflue boiler, either on Macerone's carriage or in Howard's first trial, in which the tubes were set in rows. But in later trials by Howard, in which the tubes were zigzagged, the steaming was increased by more than half, and made more rapid than that of a Lancashire boiler, while at the same time more steam was made per pound of fuel. The same effect was found by D. B. Martin. When he zigzagged his tubes he made steam faster than when he set them in rows. But he nevertheless continued to set them in rows, because it was impracticable to clean the soot from them when they were zigzagged; and Howard seems to have come back to the same practice, for his recent advertisements show the tubes set in rows, the steam connections being in the way of cleaning. Now, in this drawing, made before Howard zigzagged his tubes, I have provided for cleaning, by taking the steam down through the water, and off at the bottom, leaving the tubes clear of pipes over their tops, so that scrapers and brushes may be applied from above, if there be room enough. This room may be filled with coal, to be first burned, at the beginning of a trip.

But it is obvious that a heater must be used with this boiler, to heat the water up to the temperature normal to the pressure, say 425°; otherwise steam will be condensed in the pipes that go down through the water. But the heater will be advantageous, because it can be made of smaller and cheaper tubes, and can be arranged more conveniently as flue surface, and so that the coolest part of the smoke will act upon the part which has the coolest water in it. I did not excite myself to much enthusiasm when I made this design, and dropped it in this sketchy state when I reflected that the need of such a heater would make it objectionable for stationary engines; but I believe it may work better than any other that I have seen for ships; and if there should be a demand for such safe marine boilers, and outside engineers should be invited to offer designs, I would offer it, and talk an hour to defend it against *objections.*

A few words on the *application* of this plan may be allowed. What can we do with it? We have before Congress an application for aid to revive American shipping. Experience in England and here warns us that Congress, even if it act with the best intentions, cannot beneficially interfere in the case, except to take off the restrictions it has put on. Had Parliament never given a pound in subventions to it, steam navigation in 1855 would have been more advanced than it is now; and had Congress not followed the policy of Parliament, we should certainly not have been more thoroughly beaten than we are, and might have been in a much better position. The inexpertness of legislatures, with all the money at their command, will only maintain imitative mediocrity against original genius, and delay improvements; and the burden of taxation will be worse than uselessly aggravated, even if honestly intended. But there is too much credibility in the general opinion that the funds appropriated for such objects will be corruptly diminished by legislators and jobbers. I was credibly informed, at the time, that, out of the last appropriation of $800,000 to the Collins line, not more than $200,000, clear of expenses, got into the treasury of the company; the rest was spent in a clap-trap lobby trip, and in lobby expenses, and in bribes. And what was the engineering tendency of both English and American subventions, but to maintain side-lever engines, low pressure, paddle-wheels, and other lame crudities, that were even then condemned by all engineers of genius who dared to risk loss of reputation and employment by declaring their convictions in favor of the system I have been explaining. Professor Renwick told me that all the engineers consulted gave their opinions against side-lever engines for the Collins steamers; and at that time it had been ten years since such engines had been ordered for the British navy; yet the inexpert and timid Cunard had clung to the "successful" old style of engines, and the more inexpert and timid American imitators deemed it most safe to follow his lead. Had these incompetent men been left to compete on equal terms, they would have been beaten by the Bristol company, the screw would have been generally in use fifteen years sooner, and there would have been a fair chance for the high-pressure system to force its way, and probably it would have been in use long before this time.

But can we now recover, and lay anew our foundations, without aid from Congress? That depends on genius more than on money. If we build on the best plans, we shall succeed; if we follow, we shall fail; and Congress cannot save us, if it honestly will to do so.

Instead of robbing the people, on pretense of promoting navigation, but really to enrich jobbers and Congressmen, we should appeal to the liberal and patriotic to incur a liberal and patriotic hazard of their own money in this work. I do not so disparage human nature as to doubt that money enough can be got in this way, if the right men propose it. But if illiberal and timid and merely imitative men take the lead, men of liberality and genius will not follow them. It is understood all over the civilized world, by a few, that men of wealth and talent have peculiar duties, which they cannot neglect without failing to acquire the esteem naturally due to them. Among these duties is the promotion of liberal institutions and works, that the needy multitude can neither appreciate nor afford to pay for and really ought not to be taxed for. Appeal to that spirit! Do not pretend to offer a safe investment and sure dividend of ten per cent, but say that, whatever may become of the money, honor will not be disregarded, and the struggle for our old equality or superiority will not fail for want of certain preassurance of dividends. It must be explained and agreed, first, that the hazard is to be liberal, and in some sense heroic; second, that success is not to be sought in the old way of shunning untried plans, and adopting tried and successful plans.

And what plan can we propose to excite this spirit? First, it must offer safety to passengers. There is not a safe ship afloat. The president of the Institution of Naval Architects lately said, in his address at the annual meeting, that in six months thirty-seven steamers had been lost, all English, as I understand him. Several had never been heard from, and a frightful and atrocious loss of life had resulted. Now, it is practicable, at a cost not exceeding the insurance on cargoes of slaves, to make steamships that cannot sink, or be blown into pieces, or broken up if they get stranded. This must be done, and such boilers as I have described must be adopted. And there must be healthful ventilation. And there must be a courageous and liberal and unceasing struggle to improve the engines and boilers, so that economy of fuel, ample freight room and high speed may be attained. Safe, swift, capacious and economical; these are the qualities to aim at and arrive at, by repeated efforts if not at once. This accomplished, we shall be victorious; and the old stock of foreign steamers will be as useless as the light frigates were after our heavy frigates were built and tried, or as the Collins steamers now are.

Then let Congress, so far as it has power, compel carriers to pay $10,000 for each passenger lost, and urge other governments to do likewise, and let it leave the trade in ships entirely free from taxes and restrictions. No hindrance or help from Congress, a frank appeal to the patriotism and liberality and genius of the country. If we then fail, let us moderate our self-glorification.

Dr. Vanderweyde then spoke of the manufacture of glycerin as one of the results of Perkins' experiments with high pressure steam boilers, and sketched the apparatus upon the board.

Prof. Tillman then said the high pressure steam engine originated in this country. It was invented by Oliver Evans. Perkins, an American, went to England, and there carried high pressure to its extreme limit. He even produced a steam gun, which received much praise.

Mr. Fisher remarked that the fears of high pressure steam in England were immense. They did not dare to call the locomotive a high pressure steam engine on this account.

Adjourned.

May 26th, 1870.

Prof. S. D. TILLMAN, in the chair; ROBERT WEIR, Esq., Secretary.

MEANS OF REMOVING FOUL AIR FROM CITIES.

Professor Darby read a paper upon Malaria Chemically Considered, and especially in relation to its Removal from this city. Some points in relation to malaria were then stated. It is heavier than the air. It is present in minute quantities only. Ordinary analysis will not discover it. To use disinfectants against it is out of the question, as they do not destroy it for any length of time. In a city there are only two things that can be applied to its destruction, and these are ozone and fire. Ozone is always present in the upper regions of the air, and could we bring it down to the ground, we should always have the means of destroying the malaria. As this is impracticable, fire only remains as a method of disinfecting. A calculation which the speaker had made, showed that the large factories, sugar houses, etc., of the city, burned much more than two thousand tons of coal per day; taking one-half of this as a basis for his estimate, it was shown that thirty-six million cubic feet of air were required for its consumption. This is, in volume, equal to that contained in a tube three feet by four, and 586 miles long. In other words, the furnaces of these establishments would empty a tube of that length and capacity every twenty-four hours, if they drew their whole supply of air from it. Reducing the sewers of the city to the dimensions of three feet by four, they would form a tunnel only 260 miles long; therefore the consumption of 1,000 tons of coal in twenty-four hours, would empty the sewers twice, in that length of time. This would perfectly destroy the malaria in the sewers, and prevent it finding its way into the upper air. This scheme may be called impracticable, yet it is not so in reality. The gases of the sewers are nearly or quite all combustible, and the air being rapidly renewed, would not have time to become foul. The amount of incombustible gases in the sewers at present, without ventilation, is so small, as to be practically nothing. As malaria is heavier than the air, generated on the surface and in the gutters of the streets, it would naturally flow into the sewers, and so be burned up by the fires. In private houses it would be well to have the ranges, furnaces and stoves connected with the cellars, so that they might take their air from the lowest point in the house, while from the cellars, tubes should be extended, to take air from the top of the house.

Dr. L. Bradley said, he was better pleased with this plan than any that he had ever seen presented for the same object. He had reflected carefully upon every word that had been said, and could see no objection. Upon the theory of malaria, however, he materially differed from the preceding speaker, deeming the so-called malaria a condition of the air; but fire would destroy that condition, by making the air dry and more ready to take up the perspirable matter from the system.

Dr. J.W.Richards said he thought this as important a subject as had been brought before the Institute.

The President said that it had been proposed to stop the building of factories within the city, on account of the amount of carbonic acid generated by them; but if the plan, spoken of by Prof. Darby, was adopted, it would be perfectly proper to allow them to go on, providing they would draw the air for their furnaces from the sewers.

Mr. Beckers stated that in the new court-house in this city, the appliances for ventilating the numerous rooms, are very elaborate. The air supplied to the rooms is drawn from the top of the building, by means of steam engines in the basement.

Norman Wiard, Esq., then addressed the Association on

Wood v. Iron, as Ship-building Material.

Three or four great nations are contending for the commercial and military supremacy of the seas, and for the carrying trade of the world — England, the United States, Germany, and France. While wood was the material from which ships were made, American artizans and sailors could boast of glorious victories achieved on each occasion when they came into competition with foreigners of whatever nation, whether the trial was one of skill, strength, bravery, beauty of model or workmanship, speed, or carrying capacity, in peace or war. Our inventors conceived, constructed, and operated the first practical and successful steamboats; our citizens, sailors and merchants produced and utilized the first clipper lines of sailing vessels for long voyages; our yachtsmen won the first and the last international matches with American built and rigged yachts; and our amateur sailors were the first to inaugurate yacht races across the wide expanse of ocean. Before we were recognized as a nation, our privateersmen made themselves a terror to the mistress of the seas, and contributed greatly thereby to our final success and independence. In our first national war, that of 1812, our sailors gained gallant and glorious victories on every occasion in which the enemy was met on anything like equal terms, whether on the great deep or the lakes.

The great contest for the carrying trade of the world may be said to have begun about twenty years since between the United States and Great Britain; and, during the first ten years, our country had gained much upon her competitor. France and after Germany then entered into the competition, displaying some skill and energy, which, however, would have availed but little, had not our civil war withdrawn us from the contest for five years, and meantime thrown upon us not only the necessity of improvising a vast but temporary war navy, but also saddled upon us an immense war debt, of which we are so impatient that we are attempting to pay it off too quickly, thus making it a direct charge upon the present industry of the country only. To the five years of war we may add five years of political and industrial reconstruction; and thus we shall find, in 1872, that Great Britain will have ten years the start of us in the great race — in 1860 we were two years ahead — and other nations will be "neck and neck" with us at the same date.

The great race is only for the ocean ship-building and the carrying between Europe and the American continent on the Atlantic, and between the American continent, China and Japan, on the Pacific. For the latter, we have equal chances from this date; and undoubtedly our wealth of resources, and our aptitude in utilizing our means to ends, will give us the business on the Pacific. We now confessedly excel all other nations in the quality of the productions of our ship yards for river and coast service; and we probably keep in employment a number of such craft equal to that of all the rest of the world. England may occasionally build a river steamer for France, but she will never build one for the internal waters of the United States, or for our coasting trade; and she could not compete with us in that direction, even if there was no legal restriction or tariff in the way, plainly because we construct such vessels of wood, use coppered or sheathed bottoms which do not foul, use single engines and because all the craft in the trade are adaptations for the purpose for which they are used, due to the peculiar and practical genius and skill of American mechanics, as well as because they are better and cheaper ships for their carrying capacity, draft of water and speed, than can be produced by the artizans of any other nation, of any material. A line of English steamers put on the Mississippi, the North river or the Sound, would simply be laughed at.

I deem it not improper to mention, in this connection, that the competition of government ship-yards, dry docks and machine shops has much to do with the present depression of our ship-building interest. The English government do not build ships of war in government ship-yards, but instead, encourage the private ship-yards with their patronage; thus the best and cheapest ships are procured through public competition.

A larger number of workmen are at this time employed in one government yard at Brooklyn, under the expensive and inexpert supervision of unpractical naval officers, and a larger cost of material is daily expended in that establishment, than would be necessary to man and supply all the private ship-yards in New York. Yet it is probable that one of our private yards, conducted as intelligently and wisely as private interests would dictate, under the supervision of its proprietors, who have long practical experience, not only in manipulating material and tools, but also in managing workmen, with one-twentieth of the number of men, and five per cent of the expenditure of cost in material, would produce more completed work in ships or repairs in any given time, than is turned out at the Brooklyn navy yard. It is the conclusion drawn from long experience, that it is not every man who is adapted, by skill and knowledge of human nature, to succeed in manufacturing or commercial enterprises; where one succeeds, ninety-nine fail.

The government has no skill as a manufacturer whatever; the government manufactures must, of necessity, be produced at from ten to twenty times the market price; and while the government continues to own and operate its own ship-yards, dry-docks, machine-shops and founderies, if the depression in ship-building for commercial purposes continues, private capital and enterprise will turn away from a business which has for its only customers a corporation possessing unlimited capital to invest and expend, performing its own work in its own establishments.

The government work of building and repairing, distributed among the private yards and founderies at this time, might prevent the final closing and abandonment of many of them, so that a nucleus at least would remain for the new era.

Commercial firms would not think of erecting docks, ship-yards and founderies for the purpose of building and repairing their own ships; and such firms might do so with better propriety than the government.

There can be no progress in the way of improvement of the designs of ships, engines, boilers, etc., under government supervision in government manufactories.

Workmen cannot be chosen for the work in government yards and factories with judgment, or, in fact, with due regard for their skill, because political influence now is, and always will be, the lever foisting men into position in the national ship-yards. During the war, a young friend of mine, who had served as a soldier, asked me to assist him to get employment at one of the navy yards, which I consented to do, as I considered him worthy. He had previously been in a responsible position as clerk to a revenue officer. I supposed the employment he would ask for would be consistent with his experience, and I procured letters from an eminent editor and two members of Congress for him, with which he went to some of the magnates of the yard. He succeeded in obtaining employment.

It was a year before I saw him again, and he then told me he had been all the time employed at the yard. I asked what he was doing, and he replied:

"Calking."

"That," said I, "is a new employment for you, is it not?"

"Yes," he answered. "When I went over to the yard I was referred to the foreman of the calkers, who said he thought he could set me at work next day. After a little friendly chat he asked me if I had ever worked at calking. At first I was a little staggered; but then I remembered that I had once been employed in Dearborn's bottling establishment, putting corks in bottles, and I said I had, when he told me to come on next morning. I did so, and was set at work."

"How did you get along?" I said.

"Oh, I got along as well as any of them. I didn't do much for a week or two, but just watched the rest of them; and after that it was all right. The fact is, I didn't know what calking was when I went there, or I wouldn't have answered as I did. Perhaps if I had known better I wouldn't have got the job."

The fact is, gentlemen, that government workshops, in their effect on general and private industries, are much like the public poor-houses or State prisons; and you will concede it is a sad condition for any business to be in, when ninety-five per cent of all the skilled labor employed in like branches of trade, is in the poor-houses or State prisons, and when convict and pauper labor comes in competition with the local manufactures of the neighborhood.

It is my hope that Congress will entirely abolish all the navy yards, dry docks, founderies, machine shops, public printing houses, armories, engraving and book-binding, and manufacturing establishments now owned or operated on government account; cause the navy, the army, and the treasury to go out of the manufacturing business, which they do not understand, cannot learn, and would not practice with economy if they were skillful; and also decree that the establishments and all their appliances shall be sold at auction, and when the government wants any manufactured article, let it be procured as prudent "John Bull" procures like work, from skillful makers of the article, who do understand the art to which it relates, and from the person or establishment that will make it of the best quality for the least money.

I confess that I believe that all the branches of the trade connected with ship-building are so depressed by the long-continued competition with government factories (untaxed while the private artizan has been overloaded with all kinds of imposts); that if we could quickly restore the trades to activity, we must have complete relief from taxation, in addition to the removal of government competition. I know there are persons who think subsidies to special lines of mail steamships a remedy for the ills we bear. But the unblushing impudence of political tricksters would secure all the benefit of such a policy. The government would not think of granting subsidies to any line now established, as a help to the ship-building interest; and whenever it seems probable that Congress will be disposed to grant a subsidy to any new enterprise, fictitious companies, without a cent of capital, managed by politicians and schemers, who never owned or built a ship, and who never will, will gobble up all the benefit to be derived from the good will of our legislators.

The truth of the proverb that "Providence helps them who help themselves," has been singularly verified in the past history of the material progress of this country; and upon the energy and genius of our people, exhibited, as it will surely be, in the future, we must principally rely for re-establishing our supremacy on the seas and in our ship-yards. Yet a general law, granting preference in mail contracts to American lines of American built ships, above a fixed standard of tonnage, accompanied by frequency of trips and fair average speed, running regularly to any foreign port, would seem to be only a fair dispensation to be made by Congress, in view of the fact that foreign governments have granted such subsidies to the successful lines of foreign ships now trading with our ports, and ever carrying our mails under contracts with the United States post-office department.

If it were the fact that the ship of the future is to be made of iron, there would be left us but one course to pursue, in order to regain the ocean ship-building and steam carrying trade of the great Atlantic, namely, war, a war with England. We can never hope to excel or even equal England in building large and swift ocean mail steamers of iron. I am not here, however, as the advocate of a war with England, for I do not believe that the ship of the future is to be made of iron. I prefer to take the weather-gauge of the English ship-builders, by assisting to discover how to make a better ship of the material we have in like excess to the English supply of iron, to take the wind out of their sails, as our yachtsmen did the other day. And this I propose to do by inquiring into the bad qualities of the ships they produce, and by investigation in advance to find out how to produce a better ship than they can make without coming to us, or applying to some foreign country for the material.

If iron is the best material for ships, why do not the English build their yachts of iron, and thus beat us in the international matches? The reason is, that an iron bottom gets foul, and when covered with barnacles and excrescences cannot be so well forced through the water. Speed is one of the most important qualities, next to buoyancy, which a vessel can have, whether she is propelled by the wind or by a steam engine. A wooden hull admits of sheathing with copper or yellow metal, which keeps clean and smooth, and thus retains its speed. Iron cannot be so sheathed, because galvanic action is excited, which so hastens corrosion that an iron ship covered with copper or yellow metal would be entirely destroyed in a few months; even with the frequent hauling out, scraping and repainting, a material part of the average speed of all iron ships is lost on account of the unavoidable foulness of their bottoms. So serious has this evil been considered, that plans have been devised for covering the whole surface of the hulls of iron ships with wood, for the sole purpose of insulating the ships from the sheathing of copper. In fact, even English ship-builders have, from time to time, held that it was impracticable to build iron hulls for iron-clad ships on that account; in pursuance of that idea, most of the large English iron-clad ships have had wooden hulls, upon which the heavy iron armor was placed, or have had a wood skin put on.

The ship of the future will undoubtedly be fast, strong and durable. If fast, it will be long; and as we increase the length without proportional depth and width, we require either stronger materials or more skillful construction and workmanship. This consideration has undoubtedly had much to do with making us think that we must use iron for ships' hulls, principally from the mistaken notion that for equal weights iron is strongest.

A given weight of oak has a greater average and more reliable strength than an equal weight of iron. It is only in its lesser bulk that iron can have any conceivable advantage. And for large ships, the plan now adopted being that of making them with a double skin, *i. e.*, having one ship inside another, wood furnishes equal strength and solidity for equal bulk, *i. e.*, equal room, or greater, for freight, for equal displacement of water. The best wrought iron is about seven times as heavy as seasoned live oak, while it is only about five times as strong.

One of the principal strains to which the material of a ship is subjected, is that which has a tendency to compress it. The iron sides of a ship being comparatively thin, this strain is exhibited in a tendency to "buckle" or *wrinkle* the plates. In resistance to "buckling" equal tensile strength of wood is much superior to iron, as may be seen from the following example: Take a piece of hoop iron, three feet long, one inch wide, and of such thickness that it could easily suspend a weight of 1,000 pounds without permanent extension, and if you endeavor to use it as a column or staunchion, it will be found unable to sustain much more than its own weight, it would buckle so easily. A piece of oak of the same length and width, but of a thickness which would give it equal tensile strength, if used as a column would sustain several hundred pounds without "buckling," while its weight would be less than the piece of iron of equal tensile strength.

The strains to which a ship is subjected are different from those of most other structures, being similar to the strains upon a beam, with its load disposed upon its whole length, while its supports are shifted irregularly from the ends toward the middle of its length, and *vice versa*. A ship, therefore, requires great strength to resist transverse rupture. The large proportion of width to length of the sheets of which an iron ship is made, gives to each section of the hull a large proportion of transverse seams or riveted joints. These are lines of weakness, since such seams have but little more than half the strength of the sheet elsewhere.* It is the axiom of mechanics, that "all

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* In Fairburn's "Iron Ship-Building," we find, page 40: "We may assume the following relative strengths as to the value of plates, with their riveted joints:

Taking the strength of the plate at	100
The strength of the double-riveted joints would be	70
And the strength of the single-riveted joint	56

structures are only as strong as the weakest part;" and as these butt seams are in the transverse direction to the keel, and in the direction of the tendency of the ship to break, it can be seen that it is necessary to put nearly twice as much iron in the plates forming the skin of an iron ship as would be necessary if the whole skin could be made either of one plate or of strips of iron reaching from stem to stern. Happily, the trees from which we cut our ship timber for wooden ships furnish planks which, although narrow, have such great length, in proportion to their width, that we need not consider the loss of strength from butt-joints.*

To keep an iron ship in repair against corrosion costs more than to keep a like wooden ship in repair against decay. The corrosion cannot be prevented effectually. The latest discoveries in relation to preservation of wood give reason to hope that the wood of ships may be preserved for a much longer useful life than iron. The iron, too, decays most rapidly in the most inaccessible places.

It is asserted by the advocates of iron for ships, that iron ships may be built by machinery, thus reducing the proportion of manual labor required. The amount of manual labor required to build an iron ship, even when aided by machinery and labor-saving inventions, far exceeds the amount required for wooden ships, unaided by machinery; and the manufacture of wooden ships almost entirely by machinery is quite possible. In fact, it is easier to conceive the adaptability of machinery to the building of wooden ships than to those of iron.

Nearly all the strains to which a ship is subjected having the tendency to transverse rupture, the frame adds but little to its strength. Improvements in the mode of construction of wooden ships may, and will undoubtedly, be made in the direction of utilizing all the strength of the oak in the hull. For instance, we might make the frame of plank of double thickness, laid diagonal to the keel, like the iron diagonal braces sometimes used; and these frame-planks might then be strongly tree-nailed at each intersection; the use of marine glue for uniting the parts may be found advisable in addition. If the wood of such a frame should be preserved by antiseptics, and then well painted, it would last longer and be stronger than any iron frame of equal weight, while the cost would be much less. A lining and outside planking then put on such a frame, to make a whole thickness of fourteen or sixteen inches of preserved wood, all carefully painted, inside and out, would make a hull which, supported by orlop decks, and longitudinal and thwart-ship bulk-heads, as an iron hull must be, would be stronger by far than a double-skinned hull of iron, with inner and outer plates one inch thick each on the average, and with a frame which would have equal weight to the plates, making altogether a weight equal to twenty-eight inches of solid wood. The inferior weight of the wooden hull might be made up by increased depth, by which the wooden hull would be further increased in strength over the iron hull.

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* Mr. William Fairburn, referring to the strains upon iron ships, says: "The maximum strain upon a ship afloat appears to take place when she is supported on the crest of a wave, *as represented in figure* 2. Dr. Rankin has determined this strain to be one-fifth of the ultimate strength of the material. Now, it must be borne in mind that this apparently small strain on the material may assume the form of a destructive force when it is alternately laid on and taken off for an indefinite number of times, especially when it is considered that these strains are first in one direction and then in another; that is to say, the material in the top section (the weakest part of the section) is at one time in a state of tension, and at another in a state of compression."

When a marine architect is about to design an iron ship, see how deliberately he goes about it. All the qualities such as density, tensile strength, ductility, permanent elasticity, compressibility, resistance to buckling and torsion, rate of carbonization, magnetism, etc., of the iron to be used, are carefully considered and determined by careful experiment. The qualities of wood have so reliable a character and are so well known that it never receives so much attention. The iron of a ship must be so disposed about the structure by form and quantity that the greatest conceivable strain upon each part will only expend one-fifth its supposed ability to resist, and yet with all this caution and margin, and while the English Lloyds will continue to annually rate an iron ship A 1 for twenty-one years, if she continues in existence so long, wood only having that rating for half as many years, forty-three iron steamers are reported as lost and unheard of, and many have gone to the bottom mysteriously and unexplainably during their newness. Wooden ships have not exhibited such treachery.

Capt. Sullivan, Royal Navy, in addressing the Royal United Service Institution, in answer to Mr. Grantham's lecture on "Ships' Hulls," said:

"The observation I made that caused, perhaps, the most surprise, was that I would not even send troops in iron ships, on account of the great proportional increase of risk to those ships over wooden ships from getting on shore on rocks. I will endeavor to confine myself to-night principally to this fact, because if I show that an iron ship is not a safe ship to send troops in, if she gets on rocks, then surely we must allow that it will not do to trust such ships on an enemy's coast, so weak in their bottom that if they get on a rock they are almost sure to be lost. We must compare what a wooden ship will stand, with what the best iron ships we know of have stood. I wish to confine myself entirely to this point of getting on shore on rocks. I will allow that an iron steamer, built to run from England to America, from a safe port to a safe port, may go as safely, in the long run, as a wooden ship, because she will not be tried in this one way of getting on rocks. It is a totally different thing with men-of-war; they have to keep in with an enemy's coast, and are constantly liable to the risk of getting on rocks. But if we take these iron ships, with the experience we have derived from their getting on shore, we shall then see how utterly unfit they are to be trusted in places where they are likely to get on rocks. Let us go back to one of the earliest cases, a ship that was wrecked in North America. A naval officer has told me that he was sent to get off one of our large steamers, one of the first lost on the coast of North America, and the state in which he found her fully confirms the objection I made some time ago at this institution, that the compartments rarely save a ship, except perhaps where a ship runs her bow only on a rock, when a small bow compartment would probably save her; but where she goes on rocks in the ordinary way, you cannot trust at all to compartments saving a ship, because any one who has had a ship on a rock aground, and has looked at her bottom afterward, even if the rock is a small one, will find her bottom torn for a much greater length than the length of any of the compartments. Only yesterday a naval officer told me that he lately had his ship on shore on a rock so small that he could with difficulty keep the lead on it. His ship was beating over it, in a heavy swell, for ten minutes. When he got her into dock, though she did not leak, he found sixty feet of the main and false keel torn away. Therefore, any small rock may tear out a greater length of a ship or drive holes in her bottom over a greater length than the ordinary length of compartments. Now in the ship I alluded to in North America, the rock she ran on had not only split her throughout the whole of her bow compartment, but had split her past that compartment into one of the mid-ship compartments, both of which filled, and she was so fixed on the rock that all attempts to get her off failed. Take the case of another ship, belonging to the North American line. I mentioned the case of the 'India' before, her breaking up in an extraordinary way, and drowning all her passengers before they could get into the boats. A ship of that same company was lost shortly afterward in a way in which I believe many iron ships are lost. Should a wooden ship strike a sunken rock in passing, the heave of the sea gets her off again, and she rarely meets with such an injury as to have any risk of foundering; at least she is able, as the 'Thunderbolt' did at the Cape of Good Hope, to go along the shore, get into the first cove she can find, and save her people. But an iron ship, under similar circumstances, has her bottom so torn that she founders instantly in deep water. Now, the ship that went to North America the month after the inquiry took place into the loss of the first ship of the company was never heard of again. A few pieces of her were found on the coast of Nova Scotia, off a point where there are outlying sunken rocks at some little distance from the point. Had that ship gone on shore, some remains would have been found, but instead of that, a few bodies and some light goods with which she was laden, were the only things found. I have no doubt that in passing she struck one of these outlying rocks, and that it ripped her bottom so badly that she foundered before the people could get into the boats. Again, during the last four years, I have had to go into inquiries into the loss of four ships belonging to the Peninsular and Oriental Company in the Red sea. In a fifth case, the ship ran her bow on a coral reef, and though she filled her fore-compartment, her bow only sticking on the reef, she got off with her bow-compartment full. In four cases the ships were totally wrecked from striking on rocks. I am confident that in three out of the four cases not one of the oldest men-of-war in the service would have been lost even though flat-bottom paddle-wheel steamers. The three cases that I am alluding to are the "Ava," on the coast of Ceylon; the "Alma," on a reef in the Red sea; and one, whose name I do not recollect, at Point de Galle. In two cases the ship ran ashore in smooth water. Now, every naval officer knows if he runs his ship ashore in smooth water or in a moderate sea, so long as there is a rise and fall of tide, or after she is lightened, he can get her off; he never dreams of her bottom being seriously injured, and she must beat very heavily before he has any fear of the kind. In the case of the "Alma," she just grazed the rock first. I have no doubt that graze, which was somewhere near amidships, ripped out all her bottom plates. The next moment she struck very sharply forward, and ran over another rock. I was assured by a passenger who was wrecked in her, there was no sea to hurt her at all, she did not lift at all, it was a clean run on to a rock, yet so suddenly did she fill, that when he went below to his cabin to try and save his Crimean medals and other things, he had only time to drag his rug off his bed and put it on him, as the cabin was filling rapidly. There is no naval man who will not bear me out in saying that the worst old rattle-trap in our service would have stood any thumping like that, and if she did not get off again there would be no hurry in taking the passengers off. In the case of the "Alma," she ran on a reef, her quarter fell under water, and she so filled and bilged that all attempts to get her off failed. Now, in all these cases, where do we hear of compartments saving the vessel? We do not hear of any such cases, because the bottom of the ship is injured. In that case, in Galle Roads, the vessel was weighing her anchor. She had hove up one anchor, and she had tailed with the after-extreme of the ship over a reef; she struck heavily till they hauled her ahead, but the compartments did not save her, they had barely time to beach her as she sank under them. The after-compartments ought to have saved that vessel if compartments are of any use; it was in harbor, she only tailed her stern on the rock, and yet she was wrecked in a few minutes; we should not dream of any wooden ship suffering in that way. Here are three ships that were lost instantly. I wish to confine myself as much as possible to giving facts, which are worth fifty opinions. Of course we have the opinions of iron ship-builders, who will swear there is nothing like iron, and we have the opinions of wooden ship-builders, on the other hand, who will swear there is nothing like wood. I think those who are not interested one way or the other, only looking to get the best ships for the service, are more likely to form sound opinions than either iron or wooden ship-builders. I candidly confess I would far rather, if I believed they were the best ships, see every ship of iron to-morrow, because I know we should then have such a superiority of material over the whole world, that we should have no difficulty in maintaining our superiority; but if, with all that desire, we believe we should be wasting the public money and risking the loss of men and ships in a way that is unjustifiable, then, surely, we must go to facts and see what the results have been, and judge whether it is right to go on laying out money on iron ships.

Now I take the case of the iron troop ships. I have taken the trouble to find out what iron ships we have purchased into the service as troop ships, and what the result of their loss has been. I think every one will allow that that is a fair way to take it, and compare them with wooden ships running an equal number of years. I say these troop ships running from port to port, not running through very intricate navigation, have had much less risk of getting on shore than an equal number of wooden ships, on different stations in the world would have. During the Russian war, we know that all the smaller wooden ships in the Baltic were in the midst of dangerous rocks and intricate navigation for a period of two years. Every ship of the in-shore squadrons in that time went through greater dangers than any iron troop ship would go through. I have not taken these from any official list, but from the published navy list, and I may have made some mistakes. But the only troop ships I can find are these: "Birkenhead," "Megæra," "Vulcan," "Simoon," "Himalaya," "Urgent," "Perseverance," "Transit," "Adventure," and "Assistance." In taking the number of years they have run, I have given them credit for everything, from the first time that they were commissioned till they were lost, or up to the present time, with respect to those that are running now. I find 159 years is the total number of years run by ten ships, giving an average of nearly sixteen years each. Now, what has been the result? The "Birkenhead" was lost when no wooden ship would have been lost. The "Transit" was lost when the slightest wooden merchant ship or man-of-war could not have been lost. The "Assistance" was lost under exactly similar circumstances. The "Perseverance" was lost in an ordinary trade sea, on the coast of Mayo; but in her cas I will give iron the benefit of a doubt, whether a wooden ship migh not have been equally lost; not that I have the slightest feeling myself that she would, when I tell you that this ship came up head to the sea, an ordinary trade sea, before she struck; therefore, the sea was right ahead when she was on the rock. A back turn of the engine, with the ordinary heave of the sea, ought to have taken her off again. But she broke up so quickly that I was told by a gentleman, who heard it from the carpenter of the ship, at Portsmouth, that her fore part broke off and tumbled round alongside; and it was with the greatest difficulty they got the people into the boats, and saved them before the ship fell to pieces. Now, no one would suppose that a wooden man-of-war would have broken up in that way. But allowing that she would have been lost under such circumstances, we have three cases of loss which there can be no doubt were owing to their being iron ships; and in not one of these four cases do we find that the compartments saved them. If the compartments are so valuable, why did they not save these ships, particularly when they got on shore in land-locked seas, with smooth water. I suppose no naval officer has ever heard of a wooden ship being lost in a land-locked sea with smooth water. I have known many wooden ships running on shore in that way that did their work for months and years after, without repair. Now, I take the case of the "Assistance," because the "Transit" is a very similar case. I should like you to hear these facts, because in both cases they were troop-ships, employed at a most important time. One was going with a regiment to China, which would have been diverted to India for the mutiny, when the loss of the ship was a serious loss. The other was about to embark troops for the Peiho at Hong Kong, on Admiral Hope's expedition, the other day. I happen to know an officer that returned, the master of the "Assistance." I wrote and asked him for particulars of the loss of the ship. I may say, as the public press seem to think the naval men are generally in favor of iron ships, that, with a very few exceptions, naval men that I have spoken to, since these discussions began, agree with me. A very large majority of them say they are really glad I am working the thing, and that it is perfect nonsense to suppose that an iron ship will stand what a wooden man-of-war will."

This letter is from the master of the "Assistance," a very old naval officer:

"I rejoice to find you are fighting such a good battle with regard to the system of employing iron vessels as troop-ships and men-of-war. The 'Assistance' was sufficient to convince me that for all purposes wood must always have an enormous advantage over iron. When the accident happened she was making thirty-eight revolutions, which would give a speed of about seven knots. The water was perfectly smooth, so she remained perfectly quiet after striking; and having met the same misfortune in a wooden vessel, I was not at all alarmed for the safety of the ship. It was low water, the rise being about four or five feet. A stream anchor was laid out, and we had commenced hauling on the cable, when the carpenter reported five feet in the well, and nothing more was done, fearing the ship would go down in deep water if she came off. In four hours the troop-ship disappeared as far as the mizen mast. No ordinary wooden ship, whether man-of-war or merchant ship, would have been lost through such an accident. She might possibly have lost a few sheets of copper, or a trifle more damage, and at high water she would have come off. It was the remark of all on board that they could not have believed it possible that so slight a shock would have been the means of losing the vessel."

Now, I think we cannot have a more striking case of the uselessness of compartments. This ship ran on forward, and yet the compartments failed to save her. A slight run up on a rock makes her a wreck in a few hours, and £50,000 or £60,000 gone, when there is not a wooden ship in the navy that would not have stood twenty or fifty such blows without the slightest danger to her being sea-worthy. He goes on to compare this with the case of a wooden ship:

"I cannot but compare the cases of my striking on rocks in the 'Vixen' and 'Assistance.' In the 'Vixen' we had a gale of wind, and a very heavy sea. We were ten minutes on the rock, and so violent were the shocks that the boilers forced the upper deck up, the rudder was knocked off, and we expected she would have parted; but, having thumped over it, she made at first about a foot of water in four hours, which we reduced to a foot in twenty-four hours by cleaning her out and filling in open spaces from inside. She remained on the station two years afterward without being docked."

The "Vixen" is one of those flat-bottom paddle-wheels, which you are told would not stand so well as iron, or would not stand thumping like the rising floors. Can any one here suppose that even the "Warrior," for I will take her, if, in a heavy sea like that, she had beat over a sharp rock, dragging through her bottom, and driving up her bottom so that the boilers lifted the upper deck, can any one suppose that she would not have sunk alongside? I will give a reason why I think so, if she came off. But I also wish to give a reason why an iron ship is much less likely to come off a rock, if she strikes heavily, than a wooden one. All sailors know if a ship begins to strike heavily, and you either wish to force her over the rock or have got the anchors out to heave her off, that the first thing is to lighten her. You throw over the fresh water, the guns, and everything that can reduce the weight, in hopes of getting her off. Every one will allow that when the plates of an iron ship are perforated by these blows, one or two compartments must at least fill with water. I suppose that a ship like the "Warrior," one compartment, when full of water, would alone be something like a thousand tons. Now, if at the very time you want to lighten a ship, at the time she is thumping so heavily, 1,000 tons is added by one compartment filling, and 2,000 tons by two compartments filling, are you not binding her to the rock and removing all chance of her getting off? The "Transit" is a fourth case. The "Transit" went on shore in the Straits of Sunda. I have had the particulars of it from one of the officers who was on the court-martial. The water was perfectly smooth, and she was only going seven knots. She ran up gently on a rock, but it was through her bottom as she ran on it. One end of her, the end furthest from where the rock was, sunk almost before they could land the troops. Now, I ask any one here, not an iron ship-builder but a sailor, if the government is justified in sending out troops in ships of that class? Is it right to send out important expeditions like that, and trust the lives of the men and the success of the expedition to such ships, on a new and dangerous coast particularly, when, if they run on a rock, they instantly sink, even in smooth water, going seven knots an hour, when they can have thoroughly strong wooden ships that can thump over twenty rocks and take their troops on in safety? Not only that, but I believe we may have even stronger wooden ships.

We have not, I believe, built ships in the best way (except in a very few cases). The diagonal mode of ship-building remains to be tried. We have built the "Terrible," a very large steamer, which has worked for years, and done her work well. We have built the Queen's yacht and the "Banshee." The West India Company have built a long vessel called the "Solent." They have built without the expensive curved timber of other ships. You have only to import five or six or seven-inch straight teak planking from India. With the exception of the keel, stern-post, and the stern, and short straight floors, you can build the ship all of plank, I mean all the sides; and you do away with all the expensive curved timber. I believe that the elasticity of the diagonally built ship, from the experience we have of boats in the navy, will be found far greater than that of ordinary wooden ships. You can build those ships slightly for merchant ships; not hollow bottomed ships, as merchant ships are. I know one merchant who is having diagonal ships built. One of his vessels beat on a rock, on which an ordinary ship would have gone to pieces, and she brought her cargo home dry. We have that principle to fall back upon.

The result of the troop-ships, then, is this: On an average run of six years, the loss has been forty per cent. Now, suppose our navy of wooden ships had been lost at the rate of forty per cent in six years, what would the country have had to pay for it? I have now to make the comparison with the loss of wooden ships in the navy. I will take the two years of the Russian war, because no iron ships have ever had anything like the risk of rocks and the work of rocks that our thirty or forty smaller vessels had in the Baltic. I take the Baltic, because the fleet were in a dangerous navigation; the danger being caused by granite rocks. I do not know that any one of them went on a sandbank; I think I am right in saying, that during the first six months, every inshore ship was several times on rocks, and some of them twenty or thirty times. One officer told me that one of the new corvettes was three times on rocks in one day, and thumped heavily; any one of which blows would have caused the loss of an iron ship. Now the loss of wooden ships during the two years of the Russian war, out of 200 ships in commission, was that of one ship, the "Tiger;" she got ashore in the Black sea, and was really destroyed by the fire from the batteries; therefore, you might leave her out, though I have counted her. I have only taken into consideration the number of ships, exclusive of small craft like gun-boats; that would have swelled the number very much, and, of course, reduced the percentage. I have left out all the gun-boats in the Black sea and in the Baltic, and for this reason: We have several small iron steamers that have been running about the coast of England and on the coast of Africa. Now on the coast of Africa, a ship rarely gets ashore; it is a blockading station.

The Chairman.—The "Tamar" was lost there. She ran up on the beach.

Captain Sullivan.—I do not know the case. As a rule, it is a safe station, and we do not hear of vessels being lost there. I will set them against the small gun-boats. I do not include them in this calculation of ships. I only take the old class of ships, down to corvettes and sloops. In the two years of the war, including the whole of the work in the Baltic, we did not lose one wooden, out of the seventy or eighty vessels in the Baltic. But we had an iron transport ship, attending on the squadron; on coming home with the sick, she touched a boulder off a point, and sank instantly, and all the sick had to be landed on an island. So that while we had thirty or forty wooden ships frequently getting on shore without serious injury, that one blow did for the iron ship. Now, as to what wooden ships endure. There was only one ship, the "Valorous," that was not in perfect order to do her work, after all their getting on shore; though there were among them many flat-bottomed paddle-wheel steamers; she had been so often on shore, grinding off her fore-foot, and false keel, that at last, striking heavily on a rock, on a part where there was very little wood left, from having struck so frequently, she sprung a bad leak. But she afterward landed her troops at Bomarsund, and went on with her work for two months, and then came home to be docked. With that exception, all the fleet did their work to the end of the season. I commanded two of the weakest ships in the fleet; one was the old "Lightning," the first steamer built in the navy in 1823; she ran at full speed on an unknown rock. Her keel never touched; but a very few feet under water her bow caught the sharp edge of a rock; it threw her over so, as her bilge scraped over it, that we could hardly stand on deck; but the speed at which she was going took her over it, and she was none the worse for it, with the exception of the torn copper. That blow would have torn the bottom of an iron ship clean out. The last year of the war I had the worst vessel in the service. She was an old condemned Liverpool packet. She was built of light scantling, to run from Liverpool to Dublin. After running twenty years, she was worn out, and was patched up for the war. Being of light draught, I chose her for the work I had to do. She was repeatedly on shore; but on one occasion, when going nine knots, she ran on a granite rock so suddenly as to nearly throw the people off their legs, and then she ran her bow up, two or three feet; two frigates with their steam on and anchors could not start her till she was lightened; yet she never leaked, she did her work till she came home at the end of the season. I have been told by an officer of the "Leopard," one of those large, flat-bottomed, paddle-wheel steamers, that her false keel and part of her main keel was gone; and her bottom was looked at as a curiosity from the way in which it had been torn, from her frequently going on shore in the Baltic. If it was a small vessel, a large vessel would jerk her off the rocks; but we never dreamed of that making them unsafe. Now, if an iron ship had gone on in that way, it would have torn the plates out of her. One of our line-of-battle ships, the "Hastings," went on shore in the middle of the Gulf of Finland, on a bank with bad granite boulders. It came on to blow heavily; they were very much afraid of her, from the heavy way in which she struck. It took two or three large ships to get her off. That vessel was on these boulders for two or three days; and when she got off she came in and did her work afterward. I have no doubt a good deal of her copper and bottom was torn. No iron ship in the world, neither the "Warrior" nor any other ship, would have stood that. You must not think there is a great deal of difference between the "Warrior" and others, because, though she is double in her bottom amidships, her bilges are only single iron plate, and if that plate is torn, for at least one compartment, she gets a thousand tons of water into her. Is she very likely to come off a rock then? And is that a class of ship to be sent on an enemy's coast in a sea-way, to keep close among the rocks off Brest, for instance, watching an enemy's port, when you know if she goes on a rock in a sea-way she is gone? Would you not rather have wooden ships, that you know will do their work well, and if they get on a rock, will come off without much danger?

Now I will take the average loss of wooden ships since the war, to make sure that there shall be no unfair comparison. In the five years since the war, we have had 120 sea-going ships in commission. When this list was taken out, I had not heard of the loss of the "Wasp,"* I only heard of it within the last two or three days; but the loss in five years, out of the 120 ships was the "Polyhemus" and the "Raleigh." The "Raleigh," I have no doubt, could have been saved if they could have spared the ships and men for the work of raising her; but they were urgently wanted for the war in the Canton river. That was the case of a wooden ship striking in a sea-way on a sharp pinnacle of rock; she was able to keep afloat, and to go on for many miles till they found a place to run ashore and land all the crew. The loss out of these 120 ships is one per cent in three years and a half; and if we include the two years of the Russian war, with all its dangers, in the Baltic, the loss would be three ships, with an average of 143 ships in commission, or in seven years, less than it is out of the ten iron ships in six years. Now I do think, setting all opinion on one side, these are facts which ought to make any government hesitate before they spend the money of this country in building iron-bottomed ships; but mind, I have not touched upon the question of fouling, which at once disposes of them for foreign stations; for home service we could take them into dock and clean them. We know that the "Himalaya" if not cleaned periodically is not fit to go to sea; a very little fouling diminishes the speed one or two knots; but I rather wish to speak mainly of the question of safety, and I ask you whether with these facts staring us in the face, the loss of four troop ships out of ten in six years, I am not justified in saying, that if I had the responsibility I would not venture to send troops in an iron ship?

A very minor point must not, however, be overlooked. We know that iron ships are conductors of heat and cold. The ships have to make tropical voyages. Supposing they leave England in winter, they have to undergo constant changes from cold to heat. They go into bad climes; they go into gales, where they must be battened down. I am told by good authority that passengers by iron ships suffer much from heat in hot weather, and from the cold in cold weather. That will strike every one as being a probable thing. When you think of the thickness of the sides of a wooden ship, and how effective they are in protecting those inside from heat and cold, it ought not to be overlooked, in sending troops to foreign climes, that their comfort may be very much affected whether they go in iron or wooden ships.

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* Since got off.

But that is a question so trifling, compared with the danger of loss, that I almost doubt whether I should mention it here or not. I will mention one other fact, because it occurred to me not very long ago, to show how, even in slight cases, where the bow of a ship goes on a rock, little you can depend upon the compartments saving her.

One of our east-coast steamers, when not going very fast, ran on one of the salient points of a rock. They had stopped her; she was not going at full speed; indeed, so very slowly that her own engines backed her off. She was a screw steamer. Now we all know that if a vessel is fixed in the least, the turn astern of the engine has very little effect until we bring the weights aft. This vessel was moved astern by her engines; she was actually coming off the rock; when the engineer rushed up and said, 'She is filling!' and, to save her going down in deep water, the master was obliged to go ahead and jam her on the rock to save the people. Why didn't her compartments save her? It was smooth water; she was not very hard on shore. Are we to send vessels out like that, filled with troops? I do not say that iron ships may not be made safer if you build them with four or five thicknesses, four or five cellular bottoms; but what an expense it will be, and then they will not stand the thumping that oak and teak will stand. But while we have only this experience to guide us, it is, to me, madness to think of putting our navy on iron bottoms, or to send our troops over the world in iron ships. We do not save anything by it. The 'Warrior,' per ton, has cost more than we could build a large wooden ship for. I have been assured, on good authority, that the cost of the largest wooden hull, built diagonally, all of teak, for a powerful frigate, would be somewhere about £26 per ton for the hull. We are told that we build our ships in the dockyards rather dearly; but people, in comparing their tonnage, forget one item; they forget that ships, built on one deck, two decks, or three decks, having the same length and breadth, are of the same tonnage, while every deck adds vastly to the cost. So a three-decker, built in the dockyard, costs £33 per ton, and people compare that with a merchant ship or mail steamer, which has not got all this expensive height of decks. All that must be taken into consideration. When I speak of £26 per ton, I am speaking of a frigate like the 'Warrior,' a one-decked plated ship. If we were going to build with two or three decks, I dare say they would be dearer. I believe we can build as cheap, if not cheaper, than the 'Warrior,' a ship with diagonal planking that will wear out, if they have any practice on rocks, half-a-dozen 'Warriors,' one after the other."

But it is in the fact that the wood does not expand and contract by changes of temperature that we find its peculiar advantages as a material of which to build ships, especially steamships. We may learn, from Miller's Elements of Chemistry, that "the amount of force exerted by expansion or contraction, from the effects of heat or cold, is enormous; for it is equal to that which would be required to elongate or compress the material to the same extent by mechanical means." I have frequently presented before this association my views in relation to these phenomena, as affecting other structures of iron; but the importance of their bearing upon the question of the best material for ships is so great that I hope you will have patience with me if I refer to them again, and endeavor to show that the force of expansion and contraction from the changes of temperature is the one force acting to destroy iron ships most difficult to provide against by any known mode of construction, and most liable to cause the unexpected destruction of the ship, human life, and its cargo, so that neither can ever be heard from again. In building great iron bridges, it is well known that engineers always make provision for expansion and contraction. Stephenson's *chef d'œuvre*, spanning the Menai Straits and St. Lawrence, would topple down the granite piers upon which they rest were it not for the friction rollers upon which the slow but forcible motion of expansion and contraction is freely made. No such devices have yet been adopted by the marine architects for the purpose. In fact, it seems impossible to be done, for the ship expands and contracts with a differing rate within itself; while in the bridge all the iron is heated or cooled together.

According to the experiments of Barlow, a bar of malleable iron of a square inch of section is stretched 1–10,000th of its length by a ton weight suspended by it; a similar elongation is produced by about sixteen degrees Fahrenheit. For a variation of temperature of eighty degrees, a wrought bar of iron ten inches long will change its length 5–1,000ths of an inch, and will exert a strain, if its two extremities be securely fastened, equal to fifty tons upon the square inch, or twice its tensile strength. Calculating upon Joule's data, it may be estimated that the force exerted by heat in producing the expansion of one pound of iron between thirty-two and 212 degrees, during which it would increase about 1–280th of its bulk, would be adequate to lift a weight of seven tons to the hight of one foot, or 1,344 tons one-sixteenth of an inch high.

TUBULAR BRIDGES.*

The experiments to which we have just referred proved that a tube might be made of sufficient strength to carry the heaviest trains over rivers or arms of the sea, such as the Menai straits, and the result was the erection of the Conway and Britannia bridges, and the introduction of a new system of construction.

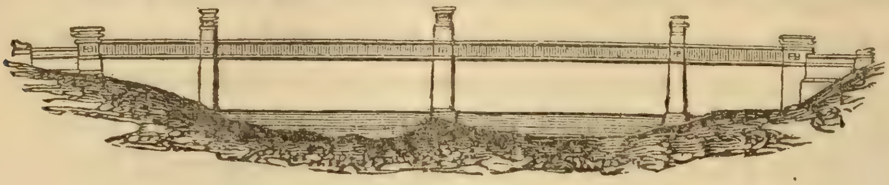

FIG. 1.

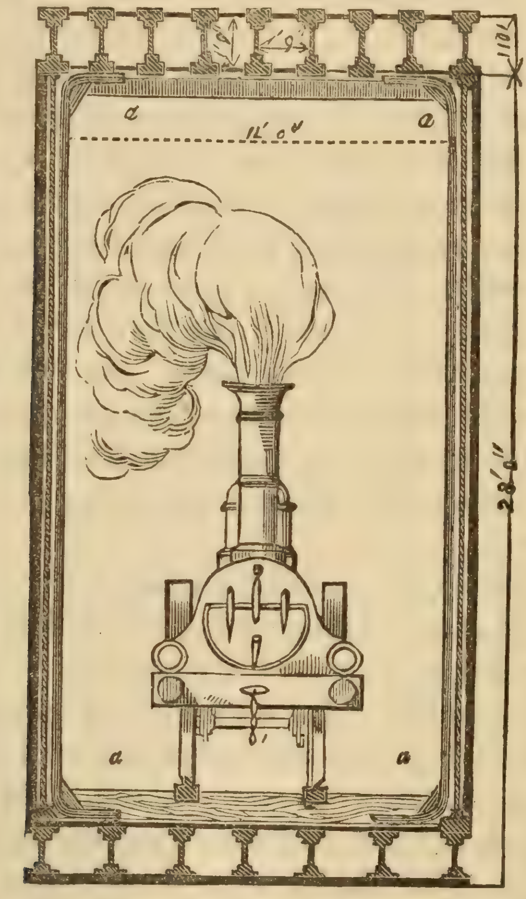

FIG. 2.

To show the manner in which the material is disposed in these bridges, we select the Britannia bridge, of which Fig. 1 is an elevation, and Fig. 2 a traverse section through the center of the tube.

The Britannia bridge consists of two wrought-iron tubes, through which the train passes. The cross section, Fig. 2, will show the peculiar arrangement adopted to give the required strength to the top and bottom of the tubes to resist the forces of tension and compression acting at those parts. It will be seen that the top is constructed with eight cells, strengthened at the corners with angle irons, thus securing a large sectional area. The bottom is constructed in a similar manner with six cells; whilst, to give rigidity to the sides, and to secure the connection of the joints between the vertical plates of which they are composed, T iron is riveted over every joint, both outside and inside, and is carried on some distance along the top and bottom, inside. The corners are also strengthened by angle plates or gussets, as shown, at *a a a a*.

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* From the "Useful metals."

The following table, giving the dimensions of both bridges, will be of interest:

	Britannia.	Conway.
Total length of each tube...	1,524 ft.	424 ft.
Total length of tube for both lines of railway........................	3,048 "	848 "
Greatest span in the clear....................................	460 "	400 "
Height of tubes at the middle..................................	30 "	25 " 6 ins
Height of tubes at intermediate piers................................	27 "	....
Height of tubes at ends..	23 "	22 " 6 "
Extreme width of tubes	14 " 8 ins.	14 " 8 "
Number of rivets in one tube......................................	882,000	240,000
Number of rivets in the whole bridge...........................	1,764,000	480,000

Opposite the point where the crossbeams are riveted in the side of the girder, plates (Fig. 3) are introduced (being riveted to the opposite T irons,) in order to throw the strain over the center of the girder, and prevent the load of the crossbeams pulling the girder out of the perpendicular.

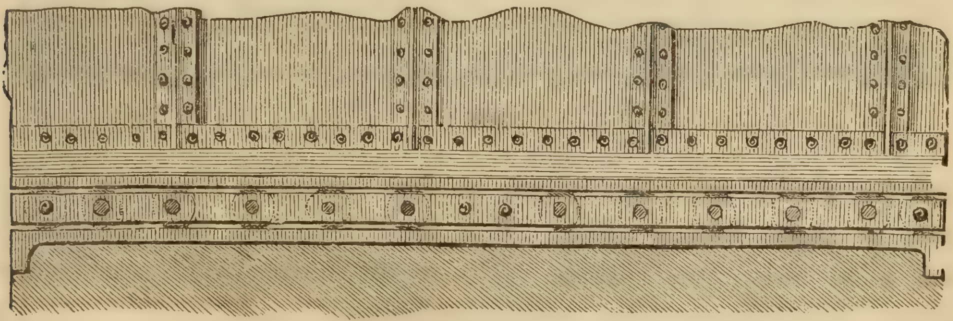

Fig. 3.

One other provision remains to be noticed. A moment's consideration will show that even ordinary changes of temperature will produce a perceptible expansion in so large a mass of metal. It is computed that ordinary changes of temperature may produce a difference in length of as much as six inches in each of the Brittannia tubes, and were not this provided against it would introduce a dangerous strain. In the present bridge the girders are fixed at the piers on cast-iron bed-plates, the expansion between those points not being sufficient to render this arrangement dangerous; but on the other two piers there is an apparatus of rollers, which allows free motion backward or forward.

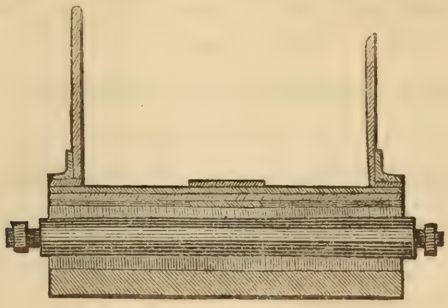

FIG. 4.

Figs. 4 and 5 show this apparatus as arranged over the piers YY. Ten wrought-iron rollers are fixed in a frame which rests on a cast-iron bed-plate, *a;* over them there is another cast-iron plate *b*, upon which the girder rest; the rollers are four inches in diameter, and are placed at eight inches apart. For the abutments this apparatus is made with only five rollers. Pieces of hard wood are inserted between the girder and the upper bed-plate.

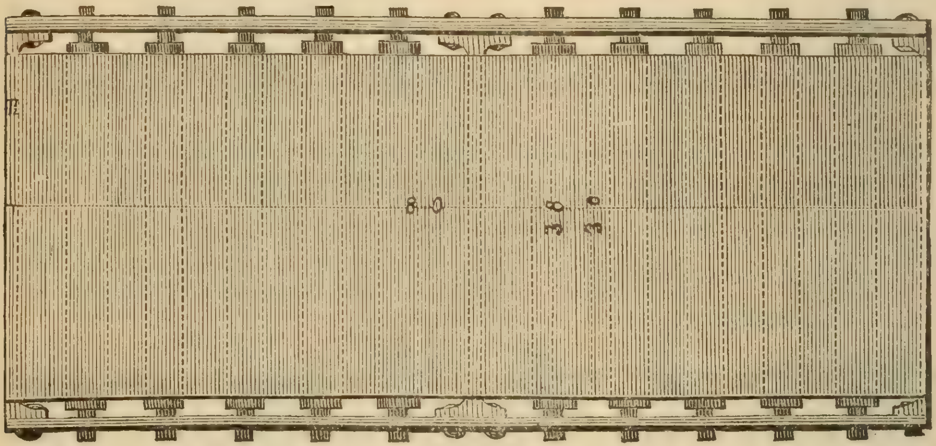

FIG. 5.

A CONSTANT AND TERRIBLE PERIL.

During the war it was common for the iron hulls of our monitors to break at the bow and stern, just under the overhang. Some of these cracks were thirty feet in length, and it was usual at the time to attribute the ruptures to the blows given by the seas under the overhang.* But when it is remembered that the wooden backing under the armor-plates covered two or three of the top courses of plates forming the sides of the hull, so as to prevent contact with the water, and if we take into account the great heat below decks in that class of vessel when at sea (the thermometer sometimes standing at 140 degrees), it can be seen that there was a force acting to break these plates much more potent than the pounding under the overhang; namely, the force of unequal expansion to which I have alluded.

The first monitor went to the bottom of the Atlantic, on account of such a rupture. The hull of the "Weehawken" broke in the same manner, under the overhang, and went to the bottom with four officers and twenty-seven men. She sank so suddenly that the persons lost, although hastily warned, could not escape to the deck.† No one would claim that there was any pounding by the seas under the overhang in this case, as the "Weehawken" was in harbor; but she had steam on, and had just closed her hatches to keep out the slight sea which was then rising, and beginning to flow over her deck. When the hatches were secured she heated up below. Her deck was then contracted, from losing some of its previous temperature, as the water began to flow over it. This would cause ruptures at the bow and stern to yawn, and admit the water which sunk her. At some time or other, the reports show that every one of the monitors with iron hulls separated at the bow or stern, by breaking away from the overhang; and when the department, having full knowledge of this difficulty, contemplated building an improved class of monitors, they did not build them of iron. The monitors with wooden hulls were supplied with an overhang. They, too, had to encounter rough seas, and were liable to pounding; but none of them ever leaked under the overhang.

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* Two or three years since I read a paper before the Polytechnic, in which I combatted this theory in relation to the separation of the hulls of the monitors under the overhang, by referring to great weight of the overhang and the armor-plates, which give such tendency of pressure upon the hull as to preclude the idea of separation by the force of the waves. As the buoyancy of the hull being the principal force acting upward to prevent the heavy overhang and armor from sinking, the force of the blow of the waves would not be sufficient to separate the parts, even if the iron was already broken.

† In relation to the rupture under the overhang of the iron hull of the monitor "Weehawken," Rear Admiral Dahlgreen reported to the Secretary of the Navy.

Flag-Steamer Philadelphia, off Morris Island, *December*, 6, 1863.

Sir: With feelings beyond my ability to express, I have to announce that the monitor Weehawken sank at her anchorage to-day at half-past two o'clock. It was blowing a moderate gale from east by north at the time, and I had been occasionally noticing the motions of the Montauk, which was anchored the highest up the harbor, and had been under way.

Mr. Hughes, the superintendent of repairs of the monitors, was talking to me at the time—asking leave to go home—when the signal officer announced that the Weehawken had flying a signal "for assistance," and this was followed almost immediately by the entrance of the fleet captain, who reported that the Weehawken appeared to be sinking.

Directions were given at once to let her make for the beach, but before the last measure could be taken, the Weehawken disappeared beneath the water, and nothing was seen above but the flag and the top of the smoke stack.

Scarcely five minutes elapsed between the time that the signal "for assistance" was made and the sinking of the vessel.

Captain E. Simpson, commanding, reported:

* * * No apprehension seems to have been felt at this time, as to the danger of sinking, the vessel was not noticed to be settling, but the commanding officer desired the presence of the captain, and commenced to signalize to that effect. At this instant the water suddenly rose in the vessel, and she commenced to settle forward. The signal "in want of assistance" was made immediately, and she went down."

"From all that I can learn, it was no gradual accumulation of water that caused the vessel to sink. but it was almost instantaneous."

THE HERETOFORE UNAPPREHENDED DANGER.

An iron ship, 500 feet long, would have her length increased six inches by an increase of temperature of 100 degrees. If her hold containing boilers had a temperature of 132 degrees, upon approaching an iceberg, her bottom might be reduced to thirty-two degrees; if she had five feet of sheer, her deck would be straightened, her bow and stern would be depressed about five feet. Her whole weight, resting on rocks at the bow and stern, would not strain or bend her one-quarter so much. If she had an inner skin, that is, a double bot-

J. M. Duncan, Commander, reported:

"About 1.30 P. M., a signal was made that the Weehawken wanted assistance. I immediately got in a boat with the pilot of this vessel. Before we could reach her she went down. Boats from all the vessels around, went to the assistance of the men that were overboard, and succeeded in saving all but four of the engineers and twenty-seven of the men. When I left the vessel, everything appeared to be right; the anchor hold was all dry; no water coming through the hawse-pipe."

M. S. Stuyvesant, Lieutenant and Executive Officer, reports:

"I have since heard from the officers of the vessel that there were leaks in all the wing-rooms, and she had been much strained from various causes. My impression is that these leaks became suddenly enlarged, filling the ship forward, and causing her to sink almost immediately.

Charles C. Kingsbury, Acting Master, U. S. N., reports:

"A large increase of weight in ammunition and coals, which, with a rough sea, and her forward compartment full of water, caused an opening between the overhang and hull, which made itself manifest by the rushing in of water in all the side rooms."

Ed. W. M. Stein, Assistant Surgeon, reports:

"Sir: I am of opinion, that the sinking of the Weehawken, was caused by the filling of the forecastle with water, which caused her to go down by the head, besides straining her to such a degree, as to separate the overhang from the hull, thereby causing a general leakage throughout the forepart of the vessel."

Frederick R. Stow, A. A. Paymaster, reports:

"I also observed the water leaking rapidly into the officers rooms, and into my own, through the seams in the sides of the ship. This latter, I had never known to occur, since I had been on board. When I observed this, I became at once convinced that she was making water fast throughout the entire forward part. When I left the ward-room, which was about five minutes before she sank, the water was an inch upon the floors."

F. N. Crandall, Acting Ensign, U. S. N., reports:

"As to the real cause of her filling with water, I am not able to state. I judge she must have parted the "overhang" from the main hull. The anchor-room is supposed to be a water-tight compartment, which being filled with water, would not affect the vessel."

Levi Pump, Pilot, reports:

"And the pressure of water was so strong, as to burst, in my opinion, the main hull from the overhang, as all the leaks started were fresh ones.

tom and sides to her hull, the outside plates would be strained by a difference of temperature of eighty degrees, about fifty tons to each inch of area of cross-section of her plates. She could not stand half so much, even if she had not her own weight to sustain. The best naval architects design their ships in such a manner that no part of the iron shall be subjected, in any contingency, at sea or ashore, to a strain or tension greater than five tons to the square inch of the iron; and when the weakness of the riveted joints is considered, it can be seen that no more should be expected of the best iron or the best workmanship. According to the authority I have heretofore referred to, a change or difference of temperature of sixteen degrees would subject the outer plates of a double-skinned ship to an additional tension of three tons to the cubic inch of iron. Such a ship, in a heavy sea, with hatches down, might, it is easy to conceive, have all her interior heated to 100 degrees. If she should approach the neighborhood of an iceberg, which would cool the water near her to forty degrees, while she was subjected to the strain which would arise from being supported alternately by the middle of her length or by seas under her bow and stern (a strain, say, of five tons to the inch of section), the additional strain from her unequal temperature would break her in two. Many ships have gone down at sea with all on board, and have never been heard from. Who can tell that the "City of Boston" was not broken in two by this heretofore unapprehended force? No word of explanation has ever come from those on board, or ever will.

Mr. Taylorson, in addressing the United Service Institution on iron ship building, said:

"It is truly appalling to read the long, sad list of casualties at sea. The similarity of narration, and almost identity of language, in which these and many other disasters are recounted, clearly show that they all originated in the same cause, the inherent weakness of which I have spoken, and the want of an adequate power of resistance to any force or strain coming in the direction already indicated; in fact, resulting from the utter radical and inherent weakness in the structure of those vessels.

"In glancing for a moment at some of those melancholy accidents recorded in the public journals of the day, I trust I shall not, in their relation, give offense to the feelings of any gentleman who hears me, for nothing can be further from my thoughts. It is the principle, not the man, I blame. Ships must be built on the present system, such as it is, until a better mode is supplied, as it is perfectly plain, from this very similarity of narration and identity of language, that the fault lies not at the door of the ship-builder, but with the system itself. In narrating the loss of the ship 'Eva,' The Times says, 'that she was struck by a heavy sea, whereby all on board were alarmed by a loud report, which, on investigation, was found to have been caused by the breaking of the keel right in the center, the vessel having broken her back.' The Times, also, in narrating the fate of the 'Birkenhead,' says: 'She went on shore and broke in two halves; 400 of the passengers perished.' The Liverpool Albion, speaking of the then new screw ship 'Yorkshireman,' says: 'She went on shore and broke in two.' The Shipping Gazette, in speaking of the loss of the 'Duchess of Sutherland,' says: 'That on entering the port of Aberdeen, she broke in two halves.' The 'Tayleur' shared the same fate, when 450 souls perished in the wreck; and in the memorable instance of the 'Prince,' at Balaklava, the Times states 'that she struck on a sunken rock, filled with water, drifted, grounded, and in less than twenty minutes she broke in two parts, and all on board were immersed in the deep.' The loss of the 'Transit,' in the Southern ocean, occurred in a similar way, her plating having split in one part, and 600 tons of water having been pumped out of her within twenty-four hours. Many similar cases might be adduced, such as the 'Nemesis,' the 'Ida,' the 'Loire,' the 'Pacific,' the 'City of Glasgow,' the 'Ada,' the 'Brigand,' etc., for, unhappily, they abound in the records of our naval disasters."

A Member.—Did I understand the lecturer correctly to say that all the ships whose disasters have been described were iron ships?

Mr. Taylorson.—All of them; and there have been a great many other similar cases. I could name fifty or more."

I feel confident that *I have shown* that iron is utterly unfit to be the material from which the large ships of the future are to be made.

That iron ships are more liable to total loss, if they go upon rocks, than wooden ships.

That the system upon which wooden ships have been heretofore principally built may be made much improved by the adoption of the diagonal system in the frames.

That there is a *constant and terrible peril attending the use of iron ships at sea,*, resulting from the force of unequal expansion, which results from unequal heating or cooling, to which iron hulls are exposed from the differences of temperature between the air in which one part of a ship is immersed and the water with which another part is in contact, as well as from the unequal heating which results from the consumption of fuel in the boilers for the generation of hundreds of horse-power of steam for the engines, by which the bottom or sides of an iron ship may be broken in two, and thus she may be suddenly lost (I flatter myself I was the first to discover this danger), and that the iron ship cannot be kept from fouling, or be sheathed with copper or yellow metal, while the wooden ship can, by which fouling is prevented, and that the best average speed can only be maintained with a clean bottom.

Let the English ship-yards turn out their iron hulls, while we busy ourselves with teaching the unsuspecting traveler the perils he encounters when he takes passage on them. Let us meanwhile go to work and devise how best to preserve wood from decay when formed into the hulls of ships. Let us increase and husband our supply of superior woods for the purpose, and contrive how to construct and fasten the frames of wooden ships so that they shall be best able to resist the strains which cause transverse rupture, and employ our ingenuity in contriving improved boilers, engines and wheels, so that, with our handsome models, coppered bottoms, and well-applied power of single engines, we may attain speed which will shame our English cousins. Then we need not care for subsidies, mail contracts, or the removal of taxes. We shall have produced the ship of the future, which is to carry the passengers and transport the freight of the future. I hope and believe it will be built in the United States, by American artizans, and manned by American sailors.

At the conclusion of Mr. Wiard's interesting paper, it was decided, owing to the lateness of the hour, to postpone discussion on it until the next meeting.

Adjourned.

June 2, 1870.

Prof. S. D. TILLMAN in the chair; ROBERT WEIR, Esq., Secretary.

The chairman presented the following interesting items of scientific news:

EFFECT OF LIGHT ON CHLOROPHYL.

The apparently spontaneous movements of grains of chlorophyll, which constitute the coloring matter of plants, when under the direct action of light, has been already observed. Borodine, a Prussian botanist, has recently made more extended and trustworthy observations by selecting for experiments a species of moss so transparent that the movements of chlorophyl in it can be perceived in it under the microscope without dissection. When kept in the dark a few days the cells of this moss had the appearance of a green network, the interstices being a clear transparent ground. Under the influence of light the grains of chlorophyl changed their position from the lateral walls, which separated the cells from each other, to the superficial walls, about fifteen minutes being required for this movement. After this, the grains mutually approached and receded. On the withdrawal of light they assumed their first position on the lateral wall. The protoplasm which surrounds the grains and causes them to move in masses of network is supposed to be the vitalizing part of the cell.

AMBROSINE.

This name has been given by Charles U. Shepard, Sr., of South Carolina, to a mineral resembling both amber and rosin, which, he thinks, originated in some of the coniferous trees that existed during the pleiocene epoch in geology, when the phosphatic formations found in that State were in progress. It differs from any of the oxygenated hydrocarbons previously known. It melts into a clear, yellowish liquid at about 450 degrees Fahrenheit, giving off a considerable amount of succinic acid before melting. After fusion it yields a volatile oil, which has a balsamic odor not unlike that from the resin of pines. Ambrosine is very combustible, and, burning without ash, gives a yellowish white light. It is soluble in alcohol, ether, chloroform, oil of turpentine, and in a solution of potash.

SIEMENS' STEEL.

Specimens of steel made by Mr. C. W. Siemens, in its various stages of formation, were shown at a *conversazione* in London, and excited considerable interest. The process of manufacture is briefly as follows: Good hematite ore and spathic ore are mixed and treated with carbonaceous materials, by which their total or partial reduction into metallic iron is effected. The metal is then subjected to very intense heat on the open hearth of a Siemens regenerative gas furnace, and in certain given quantities or series of installments is dropped into a bath of cast-iron previously prepared in the furnace. This operation is continued until the requisite degree of decarbonization is obtained, and manganese ore or spiegeleisen is added during the latter part of the process. The quantity of molten metal thus produced in one charge is about four tons. It is tipped into a ladle and poured into iron molds in the usual way, and forms steel of the highest quality. One ton of steel ingots may be produced by this process with a ton and a half of cheap small coal, while the ordinary Sheffield process requires five or six tons of fuel for one ton of steel.

THE ILLUMINATING POWER OF COAL GAS AT DIFFERENT TEMPERATURES.

Experiments have been made in the laboratory of the University of Munich to determine the extent to which the power of illuminating gas is affected by temperature, while that of air, which supplied oxygen for combustion, was not changed. The illuminating power of the gas at sixty-four and a half degrees Fahrenheit being accounted 100, as the standard, it was found that when the gas was reduced in temperature by applying cooling mixtures to the tube through which it passed, to thirty-two degrees, its average illuminating power was eighty degrees; and on reducing its temperature to four degrees Fahrenheit its illuminating power was, in some cases, thirty-three, or about one-third of its power at the standard. On the other hand, by raising the temperature of the gas to 212 degrees Fahrenheit its illuminating power was found to be 104, and on increasing its temperature to 288 degrees Fahrenheit the illuminating power was found to be 118.

NEW TEST FOR ARSENIC.

Bettendorf has found a test, so delicate, that one part of arsenic in 1,000,000 parts of solution, may be detected, and the presence of antimony does not affect it. To apply this test, the suspected liquid is mixed with hydrochloric acid, until fumes are apparent. Chloride of tin is then added, and a basic precipitate, containing the greater part of the arsenic as a metal mixed with the oxyd of tin, is thrown down.

ALBUMEN FOR INDUSTRIAL PURPOSES.

It is generally known that large quantities of albumen are consumed by certain industries, yet many will be surprised at the statement in the Paris *Cosmos*, that the cloth printing works of Europe alone, use the albumen of not less than 150,000,000 of eggs annually. This seems to be a great waste of valuable food. The albumen from the blood of slaughtered animals has long been utilized in several branches of the useful arts, and it has been proposed to use the eggs of fish for similar purposes. As yet, however, no source of albumen is found so cheap as that of eggs of domestic fowls.

The following paper was next read:

THE ORIGIN OF THE ALKALIES CONTAINED IN SOLUBLE GLASS.

By Dr. L. Feuchtwanger.

The two alkalies employed in the manufacture of silicate are potash and soda, the oxyds of the metals potassium and sodium; both of which were discovered, in 1807, by Sir Humphrey Davy. They were decomposed by him, by means of a powerful galvanic current. Before that time, all alkalies and alkaline earths were supposed to be elementary bodies. The metals have since been prepared, by heating in an iron retort, either the potash or soda, with charcoal, at a high temperature. By this process, the carbon at the high temperature, is able to take the oxygen from the potash or soda, forming a carbon monoxyd, which escapes as a gas, while the metal, either potassium or sodium, being volatile at a red heat, distills over. The preparation of these metals is attended with many difficulties, and requires special precautions, as the vapors of these metals not only take fire when brought in contact with the air, but decompose water, combining with the oxygen, and liberating hydrogen; hence the metallic vapors must be cooled with naphtha or petroleum, which do not contain any oxygen. It is indispensably necessary to distill the metals a second time, for purifying them, and freeing them from a black explosive compound, which invariably forms in the original preparation, and has caused several fatal accidents.

Potassium

Is a bright, silver-white metal, which can easily be cut with a knife at the ordinary temperature, is brittle at 0°, melts at 62°.5 Fahrenheit, and does not become pasty before melting. When heated to a temperature somewhat below red heat, potassium sublimes, yielding a fine, green-colored vapor. This metal rapidly absorbs oxygen, when exposed to the air, and becomes converted into a white oxyd. Thrown into water, one atom of potassium displaces one of hydrogen from the water, forming potassium hydroxyd, or potash. This takes place with such force, that the heat developed is sufficient to ignite the hydrogen thus set free, and the flame becomes tinged with the peculiar purple that is characteristic of the potassa compounds, whilst the water attains an alkaline reaction from the potash which is formed. Potassium also combines directly with chlorine, sulphur, and many other non-metals, evolving heat and light.

The original source of potassium compounds, is the felspar of the granitic rocks, containing from ten to twelve per cent, and mica, containing from five to six per cent of potash. Up to the present time, this source has not been used for the manufacture of the potassium salts, for the reason that no cheap and easy mode has yet been made available for separating the potash from the silicic acid, with which it is combined in felspar and mica. The grand natural source from which the supply of potash is obtained, is the ashes of wood and other vegetable matter. The potassium exists in the plants, previous to combustion, having been absorbed by them, from the soils in which they grow; the soils obtain the potash from the decomposition of rocks, clay, etc. It is also found, combined with other substances, in sea water. Potash is now generally obtained from the ashes of plants, from which it is leached out, or by filtering water through them, and boiling down the clear liquid, which, on evaporation, produces the crude potash, which is then purified. It used to be manufactured to a great extent in the States of New York, Ohio and Michigan, and was called pearl ash, and when perfectly refined, pearl or pot tartar. Some of the other potassium salts, such as the nitrate and chloride, are found in large quantities in various localities as deposits on the surface, or in the interior of the earth. The sources of nitrate of potash, or salt petre, have been sufficiently well known. The choride of potassium occurs in beds, together with rock salt, in Stassfurth, near Halle, in Prussia, in considerable quantities, and is largely employed by gunpowder manufacturers for the conversion of nitrate of soda into that of potash. There have been already described thirteen varieties, all containing the chloride with the salt. The utilization of sea water for the extraction of potash salts is about to be tried in Europe on a large scale. All potassium salts are soluble in water, and impart a violet color to flame. The spectrum of this flame is distinguished by two bright lines, one red and one violet.

Sodium.

This metal resembles, in external appearance, the metal potassium. It is, however, procured more easily than the latter, by reducing the carbonate of soda in the presence of carbon. It is now manufactured in large quantities for the preparation of other metals, especially magnesium and alluminum, as potassium was formerly used for the same purpose. The metal distils over, and is condensed in petroleum. It is a silver-white metal, soft at ordinary temperature, melting at 95.6 degrees, and volatizing below a read heat. When thrown upon water it floats and rapidly decomposes the same with disengagement of hydrogen, soda being formed. If the water be hot, or be thickened with starch, the globule of the metal becomes so much heated as to enable the hydrogen to take fire.

The compounds of sodium are very widely diffused, being contained in enormous quantities in the primitive granite rocks. They are readily obtained from sea-water, which contains nearly three per cent of choride of sodium or the common salt of the kitchen. There are large deposits of salt in Galicia, Prussia, England and this country (as is the case in Louisiana and Nevada and on the island of San Domingo), and it was formerly obtained from the ashes of sea plants, or kelp, in the same manner as potash was prepared from land plants. At present, however, the carbonate of soda is manufactured on an enormously large scale from the sea-salt, especially in England, and is known in commerce as soda-ash, which is indispensable in glass-making, soap-manufacture, bleaching, and for various other purposes in the arts. No less than 200,000 tons of salt are annually consumed in the alkali works of Great Britain.

Soda-ash is prepared from sea-salt by a series of chemical operations, such as that of the production of the sulphate or salt-cake, and the reduction of that to soda-ash. The first is obtained by heating oil of vitriol with common salt, in a reverberatory furnace, whereby the sodium is separated from the chlorine with which it is combined, and unites with oxygen and sulphuric acid to form sulphate of soda, or anhydrous Glauber salt. The liberated chlorine combines with the hydrogen of the water contained in the sulphuric acid, to form hydrochloric acid, which is collected as a commercial article. The sulphate of soda then undergoes the second process of pulverizing the same (salt-cake) and heating it with pulverized chalk and charcoal. The product is called black-ash. By lixiviation and evaporating down the solution (the heated air passing over a leaden pan containing the liquid) and calcining afterward the residue, the soda-ash of commerce is obtained. It contains from forty-eight to fifty-six per cent of pure caustic soda, combined as carbonate and hydrate, the remainder being impurities, consisting generally of sulphate, sulphite and chloride. If soda-ash be dissolved and the saturated solution allowed to stand, large transparent crystals of the hydrated carbonate, known as soda crystals, are obtained. These are used to soften water for washing purposes.

Carbonate of soda also occurs in certain localities as an efflorescence on the soil, and in the beds of dried up lakes.

At the conclusion of this paper the chairman wrote on the blackboard the formulas according to the new notation, of the most important compounds containing sodium, potassium, lithium, cæsium and rubidium.

IMPROVED PICK-AXES.

New inventions being the next item in the programme, Mr. Nimmo presented a specimen of a new cast-steel bit for pick-axes. After being cast into a shape nearly like that which it is to have, the ingot is drawn out under the hammer to the required shape.

Mr. Wiard said it was quite remarkable that people would decarbonize cast-iron, when, by not carrying the process quite so far, they could have a stronger metal, while it costs less to make it and takes less fuel.

Dr. L. Bradley thought the new picks were in form particularly favorable for strength. They are much cheaper than forged steel, and will cost the public ten or twelve cents per pound.

Mr. Wiard explained that there was some objection in the public mind to the use of steel in rails, castings, etc., on account of cracks. By proper care in casting and forging, he thought this might be avoided.

IMPROVED BUNSEN BURNER.

An improvement upon the Bunsen burner was then described. It consists in putting over the flame a wire gauze, which, by retaining the heat, enables one to keep up a very small flame with a little flow of gas. In the ordinary Bunsen burner, a large quantity of gas must be consumed for even a slight heat.

NEW GUAGE-COCK.

Mr. James Cummings presented a new guage-cock, which not only takes the place of the ordinary guage-cocks, but answers for a glass guage as well. It consists of a bent tube of some length passing through a stuffing-box into the boiler. Outside it terminates in an ordinary cock. Attached to the tube is a pointer, which indicates precisely the position of the mouth of the tube; by turning the tube upward or downward, it is possible to find the water level, if it is anywhere within two feet of the highest point.

Mr. Wiard said this would be a useful form of water-guage where the water was lifted up by steam below it, as the tube could be turned down into the steam, and even down to the lower water level.

Dr. Bradley said that the water is only lifted out of the water spaces when the engine is running, which is a useful fact, as it enabled the engineer to ascertain the true condition of the water by merely testing the guage, stopping the engine, and testing again.

Mr. Montgomery was greatly in favor of a float-guage, as giving, in his opinion, as reliable indications as could be obtained.

Dr. Bradley said floats were the invention of forty years ago, and had gone out of fashion.

Some little time was then taken up in further discussing points connected with floats, guages, etc., when Mr. Wiard's article, read at the last meeting, was taken up for discussion.

Mr. Montgomery, after some preliminary remarks upon the greater strength of iron over wood, spoke of the immense strength of the first iron ship, the "Great Britain," which went ashore, and was exposed for ten months to the pounding of the sea coming unobstructed from the Atlantic. The vessel is now afloat, in service, and apparently as strong as ever. The "Great Eastern" is called a humbug. People ask us if we cannot build ships so that they cannot sink; and yet this same ship, this humbug, lay in Flushing bay for some months with a hole in her bottom ninety feet by ten, but she did not know enough to sink. The troop ship "Sarah Sands," an iron ship, bound from England to India, took fire, had her whole stern burned out, and then carried her crew and 1,500 men into a port over 1,700 miles distant. Lardner said of ships, built as they were then, that they would not pay, and they do not; but he did say that if ships should be built of iron, and driven by a screw, and not by paddles, then they would pay, and they do. If we want a merchant marine, we must go to work.

The president remarked that it was not at all necessary to the development of this country that we have a merchant marine. Our own inland commerce is now greater than all England's. Why should we not allow her some of the carrying-trade. It was about the only great trade she had now. We built monitors, but they are useless compared with English ships of iron.

Mr. Wiard mentioned the holes in the bottom of the "Great Eastern," and thought that, had she been at sea, she would have gone to the bottom from bending. As it was, she lay in still water. He did not think there was any rock concerned in making the hole in her bottom. Nobody saw or felt any shock.

A lively discussion then took place upon the strength of iron to withstand various strains.

Mr. Wiard held that the strains to which a vessel is subjected, when supported in the center by a wave and suddenly undergoing a change of temperature, are greater than the tensile strength of the plates.

Mr. Montgomery said that, practically, a vessel's skin would be of the same temperature of the water in which she floats. The inner skin and bulkheads would be much higher in temperature, having that of the air in the hold; but the elasticity of the plates would more than make up for the unequal expansion, so that practically it would be of no importance. It is even possible to draw water, cool enough to drink, from boilers with 110 pounds steam pressure in them, showing an enormous difference of temperature in them. Yet they did not burst.

The discussion then became brisk, and turned upon questions which can only be decided by careful observations and experiments upon shipboard.

Mr. Fisher took exception to the idea that the hole in the "Great Eastern's" bottom was the result of unequal expansion. He thought the facts in the case would not bear out the statement.

Mr. Wiard, in proof of his idea, adduced the fact of the monitor's decks breaking away from the overhang, and the vessel sinking at once.

Mr. Fisher would hardly admit this as a parallel case.

The association then adjourned for its summer vacation.

October 13, 1870.

The Polytechnic Branch of the American Institute convened, after the summer recess, at their room in the Cooper Union, at half-past 7 o'clock P. M., and was called to order by the chairman, Prof. S. D. Tillman; Robert Weir, Esq., acting as secretary.

Mr. C. E. Emery, from the committee on manufactures and machinery, reported that, in conformity with the authority conferred upon them by the Institute, they had contracted with Henry M. Parkhurst as reporter for the ensuing year.

The chairman read the following notes of scientific progress:

I. Hydrate of Chloral.

Recent medical journals report favorably on the use of the hydrate of chloral, for the purpose of allaying brain excitement and producing sleep. It induces sleep with more certainty than opium, and without the injurious effects resulting from the latter. It has no curative properties, but, on account of its quieting influence, it has been called the king of narcotics.

Dr. Feuchtwanger. — The pure hydrate of chloral is given in large doses, from eight to thirty grains. It is said that it wears out; that, after reaching a certain point, like opium, it will act no more. Nevertheless, it is more pleasant to take, and more effectual, than opium.

II. PHOTOGRAPHING THE SUN.

Professor Winlock is now engaged in taking pictures of the sun on a somewhat novel plan. He uses a single lens object-glass, four and a half inches in diameter, having a focal length of forty inches, made by Clark, of crown-glass, and corrected for spherical aberration by means of an artificial star. The tube of the telescope points to the north, and the image of the sun is thrown in by means of a plate-glass reflector. This glass is not roughened or blackened on one side, because, when that was done, the heat of the sun distorted the plane surface. The slit is at the object-glass end of the telescope, so that, when it is thrown across, no dust is shaken on the plate, as frequently is the case in the usual way of working.

The chairman stated that Prof. Winlock was to have charge of one party of the expedition to be sent out by our government to the island of Sicily to observe the solar eclipse next December. Mr. Chapman, who is engaged in photographing the stars for Mr. Rutherford, goes with him. Prof. Pierce has charge of another party.

III. ON THE BREADTH OF THE SPECTRAL BANDS.

Lippich has given, in Poggendorff's *Annalen*, an explanation of the broadening and other variations of the spectral lines of luminous gases, which he ascribes to changes in temperature. The law he claims to have discovered is, that the ratio of the difference of the wave-lengths, which correspond to the borders of any spectral band to the mean wave-lengths of such band, is constant in the same gas, but in different gases the ratio is directly as the square roots of absolute temperature, and inversely as the square roots of their densities.

IV. AMORPHOUS SILICA FOR FIXING PIGMENTS.

Dr. M. Reimann describes, in *Dingler's Polytechnic Journal*, a series of experiments made with the view to apply amorphous silica for absorbing the solutions of fuchine, analine blue, etc., and to use the colored powder so prepared as a pigment for various materials. The silica is prepared by precipitating a solution of water-glass (silicate of soda or potash) with an acid, and collecting, washing, and drying the precipitate in the ordinary way. Grass, first superficially acted upon by hydrofluoric acid, and next mordanted, as is usual for cotton, assumes, when submitted to the processes in use for dyeing fibre, similar colors precisely as that fibre; the author states that this effect is caused by the amorphous silica contained in the glass and made effective by the hydrofluoric acid.

Dr. L. Feuchtwanger stated that he had used muriatic acid for that purpose.

V. AQUARIUMS.

The greenness of the water in an aquarium (says *The English Mechanic*) depends upon the amount of light admitted to it. The greenness consists of an immense number of microscopic plants produced from germs contained in water, or supplied to it from the atmosphere. Strong, bright light tends to develop there. The cure consists in removing or modifying the cause. Either put the aquarium in a shadier place, or, during the hours when the light is most intense, cover it with a sheet of light-blue tissue paper. At any rate, the light must be lessened; then the greenness will gradually disappear. The best vegetation for an aquarium is the green film which covers the stones or rock-work of either salt or fresh water aquariums. After they have been some time in operation, these can be made to grow freely or otherwise by the means indicated above. Pond, river, or marine plants of the higher order seldom do any good. Exception must be taken, however, to *valismeria spiralis*, a grass-like plant, which grows freely in fresh water aquariums, is very ornamental, and gives out a good supply of oxygen.

A member suggested *chara* as an excellent plant for the aquarium.

VI. ENGINEERING DIFFICULTIES.

Natural phenomena, says the London journal, *Nature*, must be regarded by the engineer in the tropics. Here the boring worm will teach him salutary caution. In the east we have seen a railway train stopped on an incline by locusts. The locusts have a fancy for sitting on the rails, and when the engine-wheel touches them they are crushed, leaving the rail so oily that the wheel slips. On one line, in the locust season, sand-boxes are used with the locomotive. Oysters are, however, a newly recorded enemy to the engineer. Some gourmand suggested the harbor of Tuticorin as a suitable place for oyster beds, and the Madras government, doubtless appreciative of the value of oysters, either for eating or for pearls, turned a deaf ear to remonstrance. Time has, however, justified the remonstrants, for, though the projectors have got an abundant supply of oysters, the harbor of Tuticorin is now said to be in danger of total destruction by the growth of the oyster beds, and the attention of the government is seriously directed to cross the love of oysters. The Madras coast is so ill-provided that harbors are more valuable than oysters, and a campaign will be directed against the latter, although the revenue authorities hanker after the taxes on the pearl fishery.

Mr. Fisher remarked that ten or twelve years ago the grasshoppers out west caused much trouble by stopping railway trains.

The chairman stated that the late Jordan L. Mott, a member of the American Institute, took out the first patent, more than thirty years ago, for the use of the sand-box for the locomotive.

A member referred to dried leaves as another difficulty upon the track. On the Nangatuck railroad they had caused much annoyance.

VII. Improved Spectroscope Prisms.

Professor Walcott Gibbs, of Harvard College, has experimented with various liquids as substitutes for bisulphide of carbon, now used for filling hollow glass prisms of sixty degrees. Bisulphide of carbon is cheap, colorless, and unites a moderately high mean refracture to a very high dispersive power, but it is very volatile, quite sensitive, optically, to changes of temperature, and has an offensive odor. A solution of phosphorus in bisulphide of carbon has a dispersive power fifty per cent greater than that of the bisulphide alone, but it becomes turbid on exposure to sunlight from the formation of amorphous phosphorus. It occurred to Prof. Gibbs that the formation of the amorphous phosphorus might be prevented by dissolving sulphur with the phosphorus, and experiment proved the correctness of the conclusion. His practice is to dissolve one part of dry flowers of sulphur and two parts of phosphorus in four or five parts of bisulphide of carbon, and to filter the liquid through a well dried ribbed paper. This solution gives a spectrum perfectly clear, but owing to its yellow color there is a marked absorption at the violet end of the spectrum. The disadvantage in using it arises from the danger of breaking a prism, for the liquid takes fire spontaneously when brought in contact, for a few seconds, with any porous material like wood or paper.

VIII. A Talking Machine.

For some time past (says The Observer) the London public have been informed that mechanism and invention have at last accomplished a task which has been unsuccessfully attempted by men of science in different countries for many years We refer to the talking machine of Prof. Faber, which has been exhibited on the continent with great success, and is now to be seen in London. It certainly sustains in every way the qualities its inventor claims for it, as it not only distinctly articulates in English, French and German, but laughs and hisses in the most approved fashion. The structure of the speaking apparatus, and the *bona fide* character of the results, are such as to remove the doubts of the most skeptical on these points. The machine consists of a bellows, supplied with wind by a pedal, worked by a lady, who also manipulates certain notes through whose agency the sounds are produced which form the attractions of the work. These sounds are emitted by means of a mask, resembling the human mouth, with lips, tongue and throat complete; and, in articulation, letters and syllables, the movements of these organs of speech correspond with those of the human subject. Without going further into detail, the principal upon which the instrument is constructed will be manifest, and great credit is certainly due to the invention of so delicate and astonishing an instrument. Upon the principle of the apparatus now exhibiting, others, of course, could be constructed, and although the results obtained by the one at present in use are satisfactory, yet tone and force in an increased degree could be obtained from one on a larger scale.

Dr. D. D. Parmelee.—There was a talking machine made in this city about the year 1857, exhibited on Broadway; and I was confidentially initiated into the secret. It pronounced all the elementary sounds and some monosyllables distinctly and even some dissyllables, but with difficulty, for the inventor thought it ought not to do too much. It appeared to be transparent, so that you could see through it; but, in fact, by means of mirrors a sufficient space was provided to conceal a man. It is probable that the London machine is constructed on the same principle with that exhibited in New York, and with the automaton chess player.

The Chairman.—It was my object, in presenting this note, to call out debate. Certain sounds have been made by artificial means; but I do not believe this machine would operate very well without the lady.

A NEW TELESCOPE.

Mr. Charles B. Boyd described his plan for a new telescope. It is upon the same principle as the apparatus used by Prof. Winlock in photographing the sun. A plane speculum having an equatorial motion reflects the object to a concave speculum at a distance, which in time reflects the image through a hole in the center of the plane minor to the eye piece situated behind it. This arrangement brings the minor near the observer, subject to his control. This enables us to use telescopes of a very long focus, 100 feet or more, without any great expense for an observatory, merely requiring a suitable support and protection for the speculum at a suitable distance from the observer. The principal part of the cost would be expended upon the telescope itself.

The chairman remarked that he never saw any waste room, in an observatory.

Telegraphing Storms.

Dr. D. D. Parmelee stated that the United States government had made all military stations of the United States, meteorological stations, for telegraphing reports of the weather. Had the people of Virginia, been forewarned of the approach of the recent flood, the terrible loss of life and property, would have been prevented. But there should be more stations.

The Chairman.—The losses in Virginia, amounted to several millions of dollars, a large portion of which would have been saved, if the information regarding the flood, had been telegraphed, as it might easily have been, a few hours beforehand.

Prof. James A. Whitney, who had just returned from a visit to the mines of California, read the following paper:

Three Hours in a Cinnabar Mine.

The sources of cinnabar supply are few. There are mines in South America and Mexico, but they are not worked to any considerable extent, if at all, and their value is unknown. There are others in China and Japan, the product of which is familiar to the outside world, only in the form of vermillion, or artificial sulphuret. A small one in Germany, yields a lean, poor ore, affording but five per cent of metallic mercury, and, of course, adds but little to the quantity required in the arts. The great cinnabar deposits, are only three. The oldest of these, is the mine of Almaden, in Spain, which has been worked during more than 2,500 years, until, now, it has reached a depth of 1,300 feet; it furnishes an ore retorting ten per cent of metal. This mine, in times of need, has served the Spanish crown as the basis of foreign loans, so great is its inherent wealth. The next in date of discovery, is that of Idria, in Austria, from which, for more than four centuries and a half, the government of that country has drawn an annual revenue of millions. The other is the new Almaden mine, in the San José Valley, on our Pacific coast, which is owned and worked by a company. The rough ore of this mine, was declared some years ago, capable of giving the enormous proportion of thirty-six per cent of quicksilver, but recently its richness has diminished, and the average yield is estimated at only eight per cent. It was fortunate that these deposits were discovered as they were about twenty years ago. Otherwise, a firm check would have been held upon American gold-mining, by the high prices that the foreign owners of the metal would have placed upon it, in the unprecedented demand, had there been no increased supply from otherwheres. Further, the prospective development of the mineral wealth of Northern Mexico, and of the mining regions in the Great Basin, would be much more remote than it is now, had not this abundance of amalgamating material been made available.

The Valley of San José, extends eastward from the Bay of San Francisco, and is bounded on the south by the *Lomos Bayos*, or low hills that separate it from the *Canada de los Capitancillos*, or Valley of the Little Captain, so named after a chief of diminutive stature who once ruled over it. In this is located the Cinnabar mountain, about a dozen miles from San José, the largest town in the district, and situate about fifty miles from San Francisco. The main tunnel of the mine, near the summit of the mountain, has an altitude of 1,700 feet above the sea, and 1,200, above the surrounding regions. There is no record of the date at which the first ore was found, for it is now ascertained that for ages the Indians came even from the borders of Oregon to obtain it for use as war-paint. To the whites, however, its presence was long unknown, and the first attempts at mining were directed to the discovery of gold, and failed, as a matter of course. In 1845, a Mexican cavalry officer, Don Andres Castillero, and an ecclesiastic of the mission at Santa Clara, named Real, investigated the old drift left by the aborigines, and succeeded in obtaining metallic mercury. This was done with a rude apparatus consisting for the most part of an old gun-barrel and a tub of water. Five years later a company was formed to work the mine, and ever since, save during a brief period when an injunction stopped operations, pending a legal decision, the rock has been vexed by the stroke of pick-axe and the bite of drill.

Intent upon making the journey before the heat should render it unpleasant, the writer, with Mr. J. W. Stedman, of Norwich, Conn., started early from San José one morning in August last to examine the famous drifts and caverns of the mine. Just as the gray dawn was merging into the sunrise we drove a little team and light wagon through a long tree-lined avenue into the open country beyond. In a couple of hours we reached the hacienda at the foot of the mountain, a low adobe building, where we stopped for breakfast. While the meal was preparing we took a cursory survey of the surroundings. In sight were the smelting furnaces where the metal is distilled from the ore; nearer by, the water rippling from a spring in a neighboring ravine flowed along one side of the roadway, and through ditches stopped with clods could be led on at intervals to irrigate the adjacent gardens. Close to the foot of the steep slope were two men with rectangular wooden boxes or molds, making what we supposed were adobes for buildings, but found afterward were blocks of comminuted cinnabar, fitted in this manner to be put into the furnaces with larger lumps of ore. Once there passed before the door on its way to some dwelling on the mountain a small donkey led by a slouching boy, and with two great fagots of small branches bound with withes, strapped one upon each side of the animal's back. Although there is a good road from the hacienda to the mine, such transport by mules and donkeys seems to be quite in vogue. We were told that all the water used in the village above is carried in this way. However this may be, the company have more economical means for their own purposes; the red-wood required for various uses in the mine being carried up by cars worked by endless wire ropes, so arranged that as one car ascends another descends, and *vice versa*. The same means are employed to convey the ore to the furnaces, and constitutes a great improvement over the method at first pursued of carrying it by pack mules. A mule could take but 200 pounds at a time, and make only two trips per day. The expense of running the cars, considering the work done, is quite moderate, about fifty dollars per week.

After an hour's delay we proceeded up the mountain over a broad, smooth road, steep, but of uniform grade; this latter maintained through many curves and windings, which makes the road a no slight triumph of engineering. It extends from the smelting works or furnaces to the main tunnel, two and three-eighths miles. It cost $40,000, gold. Sherman Day, now State Engineer of California, was engineer in charge, and its construction is good evidence of his skill. The scenery along the road shows at one point, at the left, a wide stretch of level, fertile land; at another, and for a greater distance at the right, the valley far below, and bright with the golden stubble of the gathered harvest.

Our travel up the acclivity being very slow, the mouths of the shafts and the places where pits have been dug in prospecting came in sight some time before they were reached, each and all being indicated by heaps of earth thrown out as if by the burrowing of some huge animal. At last we approached the village near but not quite at the summit, and comprising the dwellings of the miners, several hundred in number. Here the first object of interest is a long low shed, open at the sides, and with a railway track extending from it straight into the mouth of the main tunnel. This tunnel extends horizontally into the mountain 800 feet. At its inner end is a vertical shaft or well 400 feet or thereabouts in depth, and connecting at different levels with the various systems of drifts and tunnels. From these last most of the ore is hoisted through the well to the main tunnel, where it is put into iron cars and run out to the floor of the shed, termed the *pianella*, where it is dumped in heaps. Here it is broken by hammers from its stony matrix of serpentine, lime, and quartz, the ore being put into a pile and the refuse thrown aside. No ore is wasted, for the reason that the miners are paid, not for the entire weight of material brought out, or the exact amount of work performed, but only for the weight of cleaned ore. They receive for this from four to five dollars per *carga*, a *carga* being 300 pounds. In addition, the men with hammers are paid fifty cents per *carga* for cleaning. In separating the ore, the small fragments of stone and cinnabar form an impure material containing about 200 per cent of metallic mercury, or one-fourth of the per centage yielded by the average of the ore. To render this fit for the furnaces it must be sifted from the rest, which is done by throwing the ore against an inclined sieve with a shovel, in the same manner that sand is sifted for making mortar. Thus separated, the small material, called *tierras*, is taken to the foot of the mountain, wet with water, and sometimes mingled with a little clay to give it coherence. The plastic mass is then molded into adobes, as we saw near the hacienda in the morning, and these, when dry, are put into the furnaces like the rest of the ore. This ore is a bright-red mineral, mingled with vein matter or rock. Some is brighter and more pure; some of a duller color and less worth. At the time of our visit, considerable quantities of very fine quality were being taken from a new drift, which, if it should fulfill as well as it promised, would be very profitable, being on the main level, *i. e.*, the level of the main tunnel, so that no hoisting would be required

Most of the ore has to be hoisted from a great depth to the main tunnel, and this is costly work. When a sufficient quantity of ore is cleaned, a car is run under a trap in the *pianella*, the ore is shoveled through the trap into the car, which is then made to traverse the wire-rope railways to the furnaces below. The furnaces are so arranged that the cars can be tilted to discharge their contents directly into them, so that a second handling of the ore is avoided. In this manner the ore is disposed of, and its precious constituent made ready for use or market. Meanwhile, the stony refuse accumulates in immense heaps, and is very often much in the way.

After we had fully examined the ore and its treatment on the *pianella*, the courteous superintendent, Mr. J. B. Randol, and his overseer, Mr. James Price, an experienced Cornish miner, went with us to explore the subterranean passages of the mine. After descending the side of the mountain about a quarter of a mile, we came to the entrance of the great eastern tunnel, which is 210 feet below the level of the main tunnel. This tunnel extends inward about 1,000 feet before it commences to descend, and twice this distance before it connects with the main tunnel by the vertical shaft or well. Part of the ore carried through this tunnel, instead of being carried inward to the shaft, is taken out at the mouth of the tunnel, and after being cleaned is sent down to the furnaces another way. For this purpose the tunnel is laid with a track twenty inches wide, and is made of larger diameter than some of those further in, being six feet high and four feet wide. At the entrance, a cold blast of air strikes a chill through one's flesh as he enters its Stygian darkness. Each of our party had a candle stuck upright between two elastic strips of metal on the end of a stick, the sticks being carried slanting with the candles at their lower ends to throw the light on the slippery path. A single plank is laid between the rails for the men to walk on who move the cars. We met one of these cars at a turnout about five hundred feet from the entrance, and it was a curious thing to hear it rumble as it drew near, and to watch the dim light of its candle as it grew fainter and fainter till it disappeared in the close and murky atmosphere. Soon we passed a chute about sixty feet long, provided to enable ore to pass out the same way from the Velasquez tunnel. Further on we went down a flight of steep rough stairs cut in the rock, and came to the Prospect tunnel, all these tunnels ramifying into and connecting with each other at one point or another. Some time ago the miners struck a deposit in this Prospect tunnel, and excavated a space four hundred feet long, twenty feet wide, and thirty feet high before it was exhausted. Following our guides, we came to what they called a "prospect hole," an excavation thirty or forty feet deep. The bottom of this is reached by Mexican ladders, or *escalleras*, as the miners term them. These are simply trunks of trees seven to ten inches thick, set at a slight angle from the vertical, and having notches cut in one side for steps. All the ore from such prospect holes has to be carried up on men's backs. The miner fills a leathern sack holding often 200 pounds, and places it behind his shoulders with a strap passing over his forehead. This allows him to use his hands in climbing the ladder. He carries his load as the bulls of Assyria drew the plow, by the strength of his neck.

Desiring to go further and see the miners at work, we descended a Mexican ladder, through a jagged and narrow passage called a *chefron*, and came into a chamber of irregular shape, termed for some reason a "labor," instead of a "prospect hole," and perhaps ten feet high and three times as many broad and long. Here, in the dim candlelight, a group of miners gathered around to answer our questions, but two at the further end of the cavern kept steadily at their toil. They were drilling the rock for a blast, for blasting is needed continually both to loosen the ore and to cut the tunnels from vein to vein. One, a swarthy "greaser," sat on his haunches guiding the drill with both hands, turning it partly around at each stroke of the sledge given by his companion, a broad-chested Cornishman, whose breast heaved like a blacksmith's bellows at every blow. The laborers are all either Cornishmen who learned their business in the coal mines of Britain, or "greasers" who came from Sonora and Chihuahua in Mexico. Gunpowder is used for blasting. Nitro-glycerine and dynamite have been tried, but the men complained that the fumes of the explosion gave them the headache, and this, combined with its dangerous nature, led them to refuse to have anything to do with it. We were now many hundred feet within the bowels of the mountain, and although the air began to grow close and heavy, we sat down upon a heap of stone and ore, for this travel underground was far from easy. We asked the extent of the workings, and were answered that they include an area of more than 3,000 feet in length and 2,000 in width. This is honeycombed with miles of tunneling, and the work goes on at the rate of 1,000 feet per month. Excavating the tunnels is paid for separately from the mining of the ore. Every two weeks, this work "yarding," as it is called, because paid for by the yard, is let out to the lowest bidder. The price varies very much with the kind of rock to be cut through, from nine dollars for the soft to sixty for the hard. Last year the company paid out $90,000 in this way, and at present the monthly expense for "yarding" is between seven and eight thousand dollars. The rifts or tunnels are not run at random, but every thin thread of ore is followed up until it either disappears or develops into a deposit. After a few minutes, we went on further, passing other groups of workmen, and descending another Mexican ladder into a cavern smaller and more dismal than the one just left behind. Here we reached the lowest part of this level or system of tunnels, but another the deepest of the mine, runs a hundred feet lower down. The walls of the cavern were streaked and veined with bright-red ore, and rich masses were being taken from the floor. Water had been reached, however, and before the blasting could be carried further, a drain must be made communicating with the lower system just referred to. Here we first heard the blasting, the blasts being fired in succession in the drifts and "labors" above and around. The sound was like muffled thunder, or the far-off firing of heavy guns, slowly reverberating through the underground ways, while the air thickened and became almost irrespirable from the smoke and gases. Wishing to see all the mysteries of the mine, we asked to traverse a narrow passage which seemed to promise more rough and rugged sights than even those before us; the overseer shook his head and answered very quietly and very firmly. The men reported that a candle would not burn in the old and abandoned drift; its recesses were filled with choke-damp, and to enter there was death.

We were now 350 feet below the level of the main tunnel, and 2,000 feet in a straight line from the mouth of that, the Great Eastern, by which we had entered. Looking at our watches by the dull light of the candles, we found that we had little more than time to examine two or three of the other notable features of the mine, and so, climbing the ladders, we passed through the mazes of tunnels for hundreds of feet, to come around to the well connecting, as before mentioned, the innermost of these subterranean passages with the main tunnel above, through which the ore is conveyed to the *pianella*. Here the tunnels have narrow tracks, like those previously noticed as laid in the Great Eastern, and on them the cars run inward to the well, where their contents are deposited in iron buckets, each about the size of a barrel. These buckets are attached, one at each end of a rope running over a large pulley or drum at the top of the well, in such manner that when one bucket rises the other descends, and so on alternately. The hoisting mechanism is driven by a steam-engine of fifteen horse-power, at the inner end of the main tunnel, and also actuates a force-pump which brings water from below to feed the boiler; it further serves to drive a fan which forces an air-blast to the subterranean blacksmith shop. When one of the buckets is raised to the main tunnel, a self-acting apparatus throws it forward, and tilts it directly over the car which takes the ore to the *pianella.* The entire course followed by the ore may be thus described: The miners reach it through tunnels cut in the rock, and blast and break it from its beds, carry it in leathern sacks to the cars on their subterranean tracks, run it to the well, and transfer it to the buckets, by which it is raised to the main tunnel, emptied into other cars, run out and thrown upon the *pianella* to be cleaned, and then into still other cars, and down the inclined tramways to the smelting works, where, after distillation, or rather sublimation, the metal is put up in iron bottles or flasks holding some sixty-five pounds each, and of which about 50,000 are annually turned out from the works. Standing by the well, 300 feet or more from its top and 100 from its bottom, we noted the enormous length of the pump-rod worked by the engine above. It is made of wood, four inches square in cross-section, and balanced at intervals by levers furnished with weights at their outer ends, so that the weight of the pump-rod is practically of no account as concerns the power required to work it. In this connection, Mr. Price, the overseer, made mention of pump-rods operated in the same manner in the mines of Cornwall: "I have seen," said he, "timber pump-rods eighteen inches square, and having a total length of six hundred fathoms, connected at the joints by iron plates an inch thick, and provided at distances of 100 feet, with these 'balance bobs' made sufficiently heavy; they worked well." In this converse we recurred to the management of the miners, and were told that they work in gangs, each under a head man chosen by themselves, and in whose name all the work done by the gang is entered on the books. The gangs vary from three or four men to twenty. They are charged for their candles, for the powder required in blasting, and for pick handles, but not for steel used in tools, for repairs, or for the timber needed for various purposes in the mine. From the well we went up and on to the blacksmith shop, which is 250 feet below the surface, and devoted to sharpening drills and similar work. It has two forges, which serve for three blacksmiths, two working by day and one by night, for the miners operate day and night in alternate gangs. Passing from the smithy, we retraced our steps to the entrance of the Great Eastern, noting what had escaped our observation before, galvanized iron pipes, two and three inches thick, running along the sides of some of the tunnels to conduct air to the deeper parts, and water from others requiring to be drained. Soon we emerged from the chill darknesss of the drifts into the sunshine that makes the afternoon in this region of tropical splendor and went back to the *pianella* to visit the main tunnel, which we had not previously entered. It is ten feet broad and as many high, and, as previously noted, eight hundred feet long. Well ventilated, clean, and smoothly finished, it is a noteworthy example of subterene engineering. Leaving it, we found our time so limited as to afford no verge for visiting the smelting works, as we had intended to do. They are patterned after those of Idria, and are said to be the most efficient of any of the kind in existence. Much care is required in their construction to secure the complete separation and condensation of the mercurial vapors, and to prevent waste from other causes. Some years ago, several thousand dollars' worth of the metal found its way through the bottoms of the retorts, and permeated the ground beneath, where, after a while, it was found by accident. We shook hands with the superintendent and his foreman at the top of the mountain, rode down the steep road much faster than we had ascended, gave a last glance at the gray walls of the hacienda as we passed, and then through the pleasant level country to San José and the railway train. Returning to San Francisco, we called the day well spent, for it had given us a three hours' view of the greatest cinnabar mine in the world, and one of the most valued memories among many such, the fruits of our brief visit to the western edge of the continent.

Dr. L. Feuchtwanger expressed his pleasure in hearing the description of Prof. Whitney, for he had spent a whole day in these mines. Within the last six months, immense cinnabar mines have been discovered in Nevada, promising to excel those of New Almeda.

SILVERING LEAD PIPE.

Dr. Parmelee.—Eight or nine years ago I was asked, by persons interested in the manufacture of pipe, if it could be plated on the inside. My reply was that I could conceive of no mode by which it could be accomplished. It had been tried fifty years ago. Last winter my attention was again called to it, and I have now accomplished it. We can now line a pipe of any length, from fifty to 100 feet, with any metal that can be electrically precipitated. It had been proposed to connect the tube with the negative pole, and an internal wire with the positive pole of the battery. I first made a platform

100 feet long, at an angle of twenty degrees, to support the pipe. I then placed in the pipe, as an anode, a bar two feet long, and filled the pipe with the solution. The anode was passed through the pipe at the speed of twenty feet per hour. There was a fine precipitation of silver for four feet, and after that nothing. It soon formed a cyanide of lead.

I finally adopted the following process, which was successful: I made the anode of silver, and attached to the lower end an india rubber cone or nipple fitting into the tube so as to retain the solution. On the other end of the anode I placed a piece of dry sponge. I then put in enough solution to reach two inches above the anode. Thus arranged, I passed the anode, with its appendages, through the whole pipe, 100 feet long, without any leaking behind it, and without allowing the solution to come in contact with the pipe until the anode is directly opposite. It travels along at a speed depending on the thickness of the coating required upon the pipe. The rate of speed is regulated by clockwork. By means of Dr. Bradley's galvanometer we know exactly at every moment what precipitation is taking place, and therefore what the coating is for every foot of the pipe.

The question arises, why plate lead pipes with silver, rather than line them with tin? One objection to tin-lined pipe is that the melting point of tin is 420 degrees, while the melting point of lead is 600 degrees F. Plumbers therefore object to it as more difficult to solder, from the low melting of the tin. Besides the expansive properties of tin and of lead are so different that in passing hot water through the pipes, the tin becomes granulated and cracks. Nickel can be applied in the same manner. These samples (producing them) were plated by this process, at a cost, for the silver, of about two cents per foot.

Dr. Whiting.—Nickle deposited by the galvanic process, is exceedingly hard. Would not that be an objection?

Dr. Parmelee.—It would be, if it were thick. If put on sufficiently thin, it will not crack.

Mr. Fisher.—How would you plate with gold?

Dr. Parmelee.—In the same way. It merely requires a traveling anode, regulated by clock-work, with an India rubber cone traveling behind it.

A Member.—How do you keep up the strength of the solution?

Dr. Parmelee.—I have the best results, with a saturated solution of the cyanide.

Dr. Haven.—Do you suppose this will be as cheap as tar-lined pipe?

Dr. Parmelee.—It is not a question of cheapness. It is a question whether a man wants to be poisoned or not.

Mr. Fisher.—The difficulty is this: The man who builds a house to sell or to let, thinks it will not pay to put in expensive pipe; and unless you can furnish it cheap, he will not put it in.

Dr. Richards.—This is a very important consideration. I think it should be a subject for the exercise of municipal authority. I should be inclined to make people drink pure water, if I could. It should be a violation of law, to put a pipe into a tenement house, or into any house, that would poison the inmates.

Mr. Fisher advocated the passage of such a law by the proper authorities.

Dr. Richards.—Another suggestion. A great deal of water is now wasted from the use of lead pipe, because those who have lead pipes in their houses, and are aware of their effects, allow the contents of the pipes to run off, before drawing water to drink, or for cooking purposes. This would be unnecessary, if we used pipe which did not bring lead in contact with the water.

Dr. Parmelee.—It should be remembered that lead is a cumulative poison. Every portion of a grain, that enters the system, remains there. Many a man is laboring under the effects of rheumatism, neuralgia and similar diseases, not knowing what is the cause of it, when they are but a manifestation of the lead, which has accumulated in their systems. It is like arsenic, every fraction of which, once introduced into the system, remains there.

The Chairman, having attended the meeting of the American Association for the Advancement of Science, at Troy, in August last, selected several articles read there, relating to applied science, which he thought would be of particular interest to the members of the Polytechnic; the evening, however, was so far advanced, these articles could not be read, but they are included in the proceedings of this meeting.

A NEW FORM OF BINOCULAR FOR USE WITH HIGH POWERS OF THE MICROSCOPE.*

By F. A. P. BARNARD, LL. D., President of Columbia College, New York.

Of the several forms of binocular arrangement for the microscope which have hitherto been constructed, only such as are adapted for use with low powers exclusively, have as yet come into general use. Of these, the Wenham prism is the popular favorite, and hardly any other form is employed at all by British or American constructors. Mr. Wenham's binocular, when employed with powers below about one-half inch, leaves nothing to be desired; but with higher powers than this, the field is so imperfectly and so unequally illuminated that it ceases to be available.

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*Read August, 1870, before the Microscopical Section of the American Association for the Advancement of Science, Troy meeting.

The Wenham binocular, like the original binocular of Dr. Riddell, and like the different forms constructed by Mr. Nachet, divides the light, after it has passed the objective, by a vertical section passing through the middle of the entire bundle of pencils, into two equal portions, one of which is directed to each eye. But although the entire body of the light is thus equally divided, the same is not true of the several pencils which make it up. Only those pencils in fact can undergo equal division whose radiant points in the object lie exactly in the plane of the section. All others will be divided unequally, and the inequality will be greater in proportion as the radiants are more distant from that plane. If the division could be effected at the center of the front lens of the objective, the inequality just spoken of would disappear, but such a division is of course impracticable. With objectives of low power, the base of each conical pencil of rays (which is the area of the front lens of the system) is so large, that the inequality of illumination consequent upon the unequal division of the pencils themselves is not sufficiently great to be objectionable; but with high power objectives, the pencils are very slender; and at the distance behind the combination at which it is necessary to place the binocular construction, many are very disproportionately divided, and many escape division altogether.

By the introduction of an erector into the body of the microscope, the pencils, which cross each other once in entering the front lens of the combination, may be made to cross a second time; and it is obvious, that if the dividing apparatus of the binocular be introduced at the point of this second crossing, all the pencils will be divided with the same equality as they would be, if the division could be effected at the center of the front lens itself. Availing himself of this principle, Mr. Tolles, some years since, constructed a binocular eye-piece, which solves completely the optical problem under consideration for all powers; but this instrument is costly, and apart from this objection, it has for some reason or other, failed to become a favorite with those who have used it.

It is now two or three years since Mr. Wenham suggested the practicability of constructing a binocular for high powers, by means of a contrivance which should reflect one-half the light of each pencil, and transmit the other half. This plan was to take a glass prism, with parallel surfaces, and to cut this, by an oblique section, at an angle suitable to reflect one-half the light which should be incident upon it, after entering the prism perpendicularly, to one of the original faces. The two portions of the divided prism, being replaced in position to reconstruct the original prism, the surfaces of section being very nearly, but not quite in contact, the whole is placed behind the objective, when the transmitted portion of the light will give one image, while the reflected portion, after a second reflection within the prism, will furnish the other. In this arrangement, there is a possibility of some confusion, in the image seen by reflection, in consequence of the duplication of the reflecting surface. On this account, or for some other reason not stated, Mr. Wenham did not follow up his invention.

In the January number of "Silliman's Journal," for 1868, Professor Hamilton L. Smith, now of Hobart College, described a binocular arrangement invented by himself, in which it was proposed to effect the division of the light by means of a long thin glass reflector placed very obliquely in the body of the microscope. As both surfaces of such a mirror will reflect light with intensity, it is necessary that these surfaces should not be parallel. It was Professor Smith's first idea to make the reflecting plate sufficiently wedge-shaped to throw the second image out of the field; but experiment showed him that, by making the inclination of the surfaces very slight, the images might be made perfectly to coalesce. This construction involved the disadvantage that the length of the body of the microscope could not be varied; it was attended with an important saving of light. Hitherto Professor Smith's binocular has not been constructed by regular opticians, and its merits are not fully known. The constructions by Professor Smith himself perform very well, but have a rather limited field.

Messrs. Powell and Lealand, of London, have patented a binocular which resembles Professor Smith's in that it divides the light by reflection at the first surface of a glass mirror; but the surfaces of this mirror are parallel, and the image from the second surface is got rid of by giving to the glass considerable thickness. The reflected rays are reflected a second time by means of a right-angled prism. As this arrangement is actually constructed, the image seen by reflection is greatly inferior in brilliancy to that formed by the transmitted rays.

In fact, when very high powers are employed, the image by reflection is practically unavailable for any useful purpose. This evil might be remedied by increasing the angle of incidence at which the rays from the objective fall upon the first reflecting surface; but this expedient would be attended by a large increase in the amount of light lost at the second reflecting surface, and by a corresponding diminution of the brightness of the image seen by transmission.

Binoculars constructed on the principles of those last described may be called *cata-dioptric*, in contradistinction from those which split the body of the light geometrically, and which are properly denominated *stereotomic.* They have not the advantage which belongs to stereotomic binoculars, of presenting the object viewed in all its three dimensions. But they permit what most observers regard as very desirable, or find at least very comfortable, the use of both eyes at the same time. It is true that there are many whom practice has so accustomed to the use of a single eye, that they profess to suffer no inconvenience from this mode of observation, and regard binoculars with indifference except so far as they are recommended by their stereoscopic effect. But however slight may be the momentary inconvenience attendant on observation with a single eye, it is believed that no microscopist can continue to observe in this manner for a series of years, without finding that his eyes have lost the equal power which they once possessed of accommodating themselves to distances. It seems impossible to prevent this result from supervening sooner or later, unless by maintaining a strict impartiality in the employment of the eyes alternately at the microscope; and this is what few remember, or if they remember, are disposed to do. If by the use of a binocular this evil can be prevented, this fact alone is sufficient to make a good form of this instrnment adapted to the higher powers desirable. Such a form is believed to have been found in the construction now to be described.

If a rectangular prism of calc spar be cut with four of its faces parallel and the other two perpendicular to the direction of the optic axis, a ray of light incident perpendicularly upon any one of the lateral faces will be divided by double refraction into two rays, but both of these two rays will pursue the common direction of the incident ray continued. There is a large difference between the two indexes of refraction. The index of the ordinary ray is 1.6543, and that of the extraordinary, 1.4833. If now the prism be divided by a plane section oblique to the axis, the two rays co-incident in direction, as above supposed, will be unequally reflected by this plane. And the ordinary ray will suffer total reflection at an angle at which the extraordinary ray is almost totally transmitted. The angle of total reflection for the ordinary ray is thirty-seven degrees eleven minutes, while that at which total transmission occurs for the extraordinary ray is thirty-four degrees two minutes. From thirty-four degrees to thirty-seven degrees, the amount of light reflected from the extraordinary ray is inconsiderable, amounting at the latter angle not quite to eight one thousandths of the entire ray, and to four one-thousandths of the total intensity of the ray originally incident upon the prism. If, therefore, the supposed calc spar prism were cut by a plane, making an angle of thirty-seven degrees eleven minutes with one of its lateral faces, a ray incident perpendicularly upon this lateral face and meeting the plane of section, would be half reflected and half transmitted, or so nearly so that the inequality would be imperceptible. Moreover, the very minute portion of the extraordinary ray which would undergo reflection, would deviate more than two degrees from the direction of the reflected ordinary ray; and so supposing this prism to form part of a binocular arrangement for the microscope, would be thrown out of the field.

But the pencils of rays which go to form the image in the body of the microscope have a certain angular spread. If, therefore, the axis of the central pencil be perpendicular to a given plane, those of the lateral pencils will be inclined to the same plane. Accordingly if this central axis were to be incident on the supposed plane of section at thirty-seven degrees, the incidences of the lateral pencils would vary between thirty-four degrees and forty degrees, or possibly between limits somewhat larger. Also as the lateral rays of each pencil are inclined more or less to the axes of the same pencils, the limits of maximum and minimum incidence would be more largely extended by this circumstance. For low powers we should have to allow for a range of incidences embracing perhaps eight or nine degrees of difference. For very high powers this range would hardly exceed six.

If the incidence of the central axis is fixed at thirty-seven degrees eleven minutes, the angle of total reflection for the ordinary ray, then the lateral pencils of this ray, whose incidences are less than thirty-seven degrees eleven minutes, will be to a certain but not very considerable degree transmitted. This does not affect the definition of the image seen by transmission, but it gives it a slight superiority to the other in respect to brightness. If, however, the incidence of the central axis is made as great as thirty-nine degrees, the two images become sensibly equal in brightness. In this case some of the lateral pencils of the extraordinary ray will attain an incidence of forty-two degrees, at which point the amount of reflection is quite sensible, but this does not materially affect the middle of the field, nor is it sufficient to impair, perceptibly, the brilliancy of the image seen by transmitted light.

It is now about three years since the plan of a binocular, founded on the principles above explained, was devised by the writer of this paper; but this plan was not immediately realized in consequence of a difficulty encountered in obtaining calcite prisms suitably prepared. Opticians were applied to in London, and in this country, but no one was found willing to attempt the preparation. In the spring of 1869, Professor Rood, of Columbia College, kindly lent his aid to the accomplishment of this undertaking, so far as to verify, experimentally, the anticipations of theory; but time would not permit him to give to the prisms the finish required for a perfect instrument. The work was finally done during the following summer by Hoffman of Paris, with results entirely satisfactory.

In the original construction, the calcite prism was made rectangular. The ordinary ray, after reflection from the surface of section, emerged from the terminal plane, at an incidence of twelve degrees. It was reflected a second time, by means of a triangular prism of flint glass, having nearly the same index of refraction, of which the first surface was placed parallel to the terminal plane of the calcite. It was thought that the very nearly equal and opposite refractions, thus suffered by the ray, would suffice to prevent sensible aberration; and this is nearly true. But the unequal, dispersive power of the two substances, makes itself slightly manifest, when the objectives used are low; though this defect disappears, in the case for which the instrument is intended, that is, with high powers. Nevertheless, it has been thought best, in new constructions now preparing, to give such an obliquity to the terminal plane of the calcite, that the reflected ray may be incident upon it perpendicularly, and to modify correspondingly the flint glass prism. On the whole, it appears to be best also to give the plane of section an inclination of about 38° instead of 39°. Indeed, it would appear, that for low powers, the lower angle is preferable, and for high powers, the higher; doubtless, because on account of the larger range of differences of incidence in the former case, there is a larger reflection of the extraordinary ray, which is greatly reduced by a very small change in the angle of incidence. For this reason, it is convenient to have the system of prisms so mounted, that it can receive a slight rotation about an axis perpendicular to the plane of reflection, and to adjust it to the position most satisfactory with the power employed

The annexed figure (140) will serve to give an idea of the form of construction now employed. ABCD is a section, parallel to one of the lateral faces, of a calcite prism, originally rectangular, of which the optic axis is parallel to the section, and to the sides AB and DC. This prism is divided by a plane perpendicular to ABCD, making an angle of 38° with AB and 52° with AD. Also, the face, BC, inclined 14° to the original face of the rectangular prism, is made to replace that face. The prism, when completed, should have its lower face square, and the side of the square which is equal to DC, should be six-tenths of an inch. The remaining dimensions will be determined by this, and by ED, which should be three-twentieths of an inch. The surfaces of section, BE, may be brought very near to each other. In the construction actually employed, they have been separated only by a single thickness of tinfoil, introduced at each of the angles.

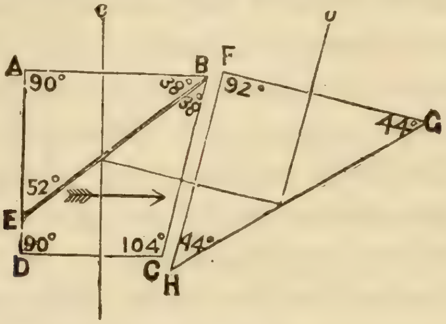


Fig. 140.

The prism, FGH, is of flint glass, with a refracting index as high as 1.56 or higher. It is isosceles, having an obtuse angle of 92° at F, the acute angles being equal and each 44°. The side, FH, being parallel to BC, a ray incident perpendicularly upon DC, and doubly refracted by the prism, is resolved into the two rays, *e* and *o*, of which the first is transmitted, and the second, reflected by BE, passes perpendicularly through the two surfaces, BC and FH, is a second time reflected by GH, and finally emerges at right angles from the face FG. The inclination of *o* to *e* is twelve degrees. It would be preferable to make it somewhat less, as this inclination allows only a length of body to the microscope of about seven inches. By employing in the prism, FGH, glass of higher refracting power, it may be made less, and by using calcite for this prism, or, in other words, by making BCDE and FGH all of a single piece, the same object may be attained to any desired degree. The objections to this latter plan are twofold. The first relates to the difficulty of construction. It is said that the Wenham trapezoidal prism of glass is troublesome to make. The difficulty would be much increased in the use of such a material as calcite, especially when it is necessary to preserve an exactly prescribed relation between the faces of the prism and the optic axis. The second objection is found in the consideration that, in order to adapt the tubes of the binocular to the eyes of different observers, it is necessary to give to one of the tubes an angular movement, moving the prism, FGH, at the same time, by half the same angular amount, as is done by Mr. Nachet in one of his forms of binocular; or to move this tube and prism laterally, as Mr. Nachet has also done in another of his forms. This necessity arises from the fact that, if the tubes are sufficiently inclined to each other to permit an accommodation to different eyes by running them in and out, as is done by Mr. Wenham, they must be made shorter than is desirable. The reflected pencils might be made to cross the transmitted before reaching the eye, as is done both in Wenham's and in Powell and Lealand's contrivances; and this would remedy the inconvenience last mentioned, but it would necessitate the use of a prism, in place of FGH, of difficult construction, and of greater size than is desirable.

But there is another objection to the crossing of the pencils which is more serious. This binocular, as actually constructed, produces, when used with moderate powers, a sensibly stereoscopic effect. Nor is it difficult to understand why it should do so. In any stereotomic binocular, Wenham's, for instance, it will be observed that the half of each pencil that falls upon the front lens of the objective, is carried to the opposite eye; and this ought to be so, because the image actually seen is reversed in position. Now, by considering the figure annexed (141), it will be seen that if $aa' \, a''$ be the axial ray of a converging pencil of which $bb' \, b''$ and $cc' \, c''$ are the lateral limiting rays, and if a transparent reflector, MN, be interposed obliquely in the path of this pencil, the angles of incidence of all the rays intermediate between a' and b' will be larger than those of the rays between a' and c'. Of

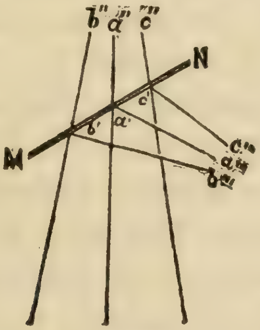


FIG. 141.

the reflected rays, therefore, those between a''' and b''' will be more abundant than those between a''' and c'''; while of those which are transmitted the excess will lie between a'' and c'', and there will be a corresponding deficiency between a'' and b''. Now, if all the light except these excesses should be extinguished, it will appear at once that the illumination still outstanding would be such as is required to produce stereoscopic vision; that is, each half of the pencil would go to the opposite eye. In our calcite prism, we have seen that in, for instance, the central pencil, there is total reflection for the ordinary ray between a' and b', but that there is some transmission toward c'. The extraordinary ray, on the other hand, is almost totally transmitted between a' and c', and loses something by reflection toward b'. These effects are more marked in some of the oblique pencils, and the consequence is, that, with low powers, the stereoscopic appearance is very perceptible. To cross the reflected rays upon the transmitted behind the prisms would, therefore, be productive of a pseudoscopic effect which would be objectionable. But with high powers, on account of the small difference of incidence existing in that case between bb' and cc', the image appears plain.

As a test of the performance of this binocular, it may be mentioned that, by means of it, the most difficult natural objects have been resolved by observation with both eyes, or with either eye singly. With a Wales' objective marked one-thirtieth, but more exactly rated one-twenty-fifth, and with the binocular, the Providence Grammatophora is thus resolved with great facility.

When the power used is below one-fourth, there is a little haziness produced in the image seen by reflection, in consequence of the mingling of the (to some extent) reflected extraordinary ray, from the clear field surrounding the object. This effect is immediately removed by placing over the slide a card, out of which has been cut a slip having the width of the field. Such a card, or a similar thin plate of metal, may be easily secured to the stand, so that the stage and slide may move beneath it while it remains fixed. This haze is moreover suppressed still more easily by slightly tilting the system of prisms, so as to diminish by a degree or two the angle of incidence upon the reflecting plane of section. This really gives to the image seen by transmission the advantage in respect to illumination; but as, with low powers, both images are strongly illuminated, the difference is scarcely noticeable. It is well, therefore, in mounting the prisms, to provide some system of adjustment by which the position may be varied to correspond to the power employed.

Some experiments have been made with calcite prisms cut in such a manner that the extraordinary ray proceeding from common light perpendicularly incident upon the first surface, should fall at a smaller incidence than the ordinary upon the surface of the reflecting section. Thus, if, in figure 140, the optic axis has the direction BE the extraordinary ray will deviate toward the left, from the ordinary, after perpendicular incidence on DC, by nearly five degrees. This is favorable to the transmission of the extraordinary ray through BE; but as the index of extraordinary refraction is considerably greater in this direction, the amount of loss by reflection is about the same as before. The construction employed at first gives results which are very satisfactory; but it is designed to pursue experiment further, and with the able assistance of Mr. Joseph Zentmayer, whose zeal for the improvement of the microscope has induced him to undertake the rather troublesome task of preparing the prisms, it will soon be ascertained whether or not any material advantage can be gained by adopting a different plan of cutting them.

THE CHEMISTRY OF THE BESSEMER PROCESS.

Read before the American Association for the Advancement of Science, at Troy, August, 1870. By Lieut. C. E. Dutton, Ordnance Corps, U. S. A.

The form in which iron first makes its appearance in the arts is usually that of cast-iron. This is an impure species of the metal; the impurities being rendered necessary by the nature of the blast-furnace process, which cannot effect the reduction of the iron from the ore without introducing also certain other elements in the form of alloys or chemical combinations. In order to obtain the malleable iron, which is a nearly pure metal, it is necessary to remove these impurities. Steel is intermediate between cast and wrought iron, both in respect to its chemical constitution and its mechanical properties, being iron with a slight admixture of carbon. The order in which these three species succeed each other in their production is, first, the reduction of the cast iron from the ore; second, its purification or reduction to wrought iron; third, the conversion of wrought iron into steel, by the addition of a small percentum of carbon. This order is sometimes deviated from, but very seldom with advantage, and never except under peculiar or local circumstances, when it is difficult or impracticable to carry it out. The order given is the normal one; is by far the cheapest and the most rational. We shall not discuss here the blast-furnace process, but merely those by which cast iron is reduced to wrought iron, and wrought iron converted into steel. They are many in number, varying widely in the mechanical means, and the materials employed to effect them. But the chemical principles and reactions involved are not merely similar, but, in most cases, very nearly identical, whether occurring in the finery, the puddling, the Bessemer, the Heaton, or the Siemens-Martins processes. What differences occur are, with exception of some specific cases, entirely mechanical, and confined to the mechanical means of bringing these reactions about. The specific cases alluded to, as in some respects exceptional, are those in which some new element is used to modify these reactions, such as the use of furnace powders, or, as they are correctly termed, "chemicals," or, as the workmen pithily call them, "doctors' stuff." These sometimes introduce new elements, which give rise to slightly modified reactions; but their use is limited, and, in very many cases, merely involves that principle known to the chemist as the law of substitution; and hence is not so great a modification, after all. Let us, then, proceed to characterize these reactions.

Cast-iron, the raw material from which the malleable metal is made, may be furnished approximately as follows:

Silicon, (Si)	5.	to	3 per cent.
Phosphorus, (P)	0.05	to	2 per cent.
Manganese, (Mn)	0.	to	20 per cent.
Sulphur, (S)	0.25	to	2 per cent.
Carbon, (C)	2.0	to	5 per cent.
Iron, (Fe)	90.0	to	96.5 per cent.

It is a rare thing if pig-iron do not contain every one of these elements, excepting manganese, in proportions within the limits here given. Although manganese is oftener absent than present, yet its importance is so great in the metallurgy of iron, that I have deemed it necessary to introduce it into the discussion, particularly as its importance is greatest of all, in the Bessemer process. The percentages given, are neither the highest nor the lowest, but may be considered as the extremes of the normal varieties. Some few extraordinary brands have been known to exhibit very remarkable constitutions, such as eight per cent of carbon, and twelve to fifteen per cent of silica, but these are mere curiosities of metallurgy, and not useful or practicable material.

Adverting to the table, the chemist will immediately notice two things: 1. All of these elements are highly oxydizable. 2. The iron is the least readily oxydized of all.

(I have arranged the elements in the order of the readiness with which they combine with oxygen.) What ought we to expect then, when cast-iron is subjected in a fluid state, to the action of oxygen? First, we may expect that they would all oxydize. Second, that though they may all oxydize, yet, in consequence of the more powerful affinities of some of the elements (silicon for instance), these would not only consume free oxygen, but would attack the weaker affinities (iron, for instance), decompose them, and appropriate their oxygen also. Now these things are approximately what happen. When iron begins to melt in the puddling furnace, or finery, as soon as an atom of oxygen alights upon the fluid metal, it is taken into combination by one of the elements. If it touch the silicon, it is retained; but if it touch the iron, it is retained only until the molecule of oxyd of iron, encounters an atom of silicon, when the latter element instantly robs it of its oxygen and retains it. And this interchange goes on, the iron acting as a sort of carrier of the oxygen, until most of the silicon is satisfied. When this is accomplished, a similar process goes on with the other elements, only a small portion of the iron remaining oxydized, because it is compelled to yield its oxygen to its more tenacious neighbors. Last of all, the carbon comes in for its share and is the last to burn out.

But let us examine in detail the behavior of these six elements, as manifested in the ordinary puddling process, and thus we shall be able to determine in what respect the Bessemer differs from it, and whether there really is any essential difference. Let us take the elements in the order given, which is the order in which they are eliminated.

The puddling process is performed in the ordinary reverberatory furnace, in which the flame plays over the surface of the metal. The hearth is lined with iron ore or some other oxyd of iron, which furnishes some of the oxygen required for the reaction, the remainder being supplied by the atmosphere carried in by the blast. The metal selected is usually one containing small quantities both of carbon and silicon, and which melts very gradually, becoming soft and pasty before it melts. The advantage of this slow melting is, that the metal becomes considerably oxydized early in the heat, the successively liquifying portions being successively exposed to the oxygen of the blast. When the charge is melted the first reaction is the oxydation of the silicon, forming silicic acid, which is composed of one atom of silicon to three of oxygen (SiO_3). Now this compound is a powerful acid, and, like all other acids, has a strong tendency to unite with some base, provided it can find one, and it does find one very readily. The base with which it will unite must be an oxyd of some substance. If manganese be present it will, from preference, combine with the oxyd of manganese; but if none be present, it will combine with the oxyd of iron. Now this element (silicon) is so powerful in its affinities that it is not content with robbing every other element, especially the iron, of what oxygen they can get, but even after it has been oxydized, and become silicic acid, its appetite is by no means satiated. In its new form it now proceeds to appropriate and consume oxyd of manganese and oxyd of iron, until every molecule of silicic acid has secured either one molecule of oxyd of manganese or three of oxyd of iron. The resulting product of this silicic acid reaction is a silicate of manganese and iron, which is not subsequently decomposed. It is a very fusible compound, and is the slag or "top cinder," as the workmen term it. It becomes a kind of broth or mother-liquor, in which the remaining charge is cooked, and is nearly all thrown away afterward, only a small portion of it being available for further use.

The next element which undergoes change is phosphorus. The great affinity of this substance for oxygen is well known to you, being manifested by the violent manner in which it burns in the atmosphere. And yet there seems to be great difficulty in oxydizing phosphorus in the puddling furnace, and in the Bessemer converter it does not appear to oxydize at all. This can only be explained by assuming that its affinity for iron is as great, if not greater, than its affinity for oxygen; still it is, to a considerable extent, oxydized in the puddling furnace, and most decidedly so when manganese is present. But it often happens that a considerable part of the phosphorus remains in the iron unchanged. That portion which is oxydized becomes phosphoric acid and ($P\ O_5$).

I strongly incline to the opinion that the affinity of phosphorus for iron increases with the heat. In the Bessemer process, where the heat is most intense, the phosphorus is not eliminated in any perceptible degree. In the Siemens-Martin process, where the heat is much greater than in the common furnace, it is removed only in a small degree, the greater portion still remaining as phosphide of iron.

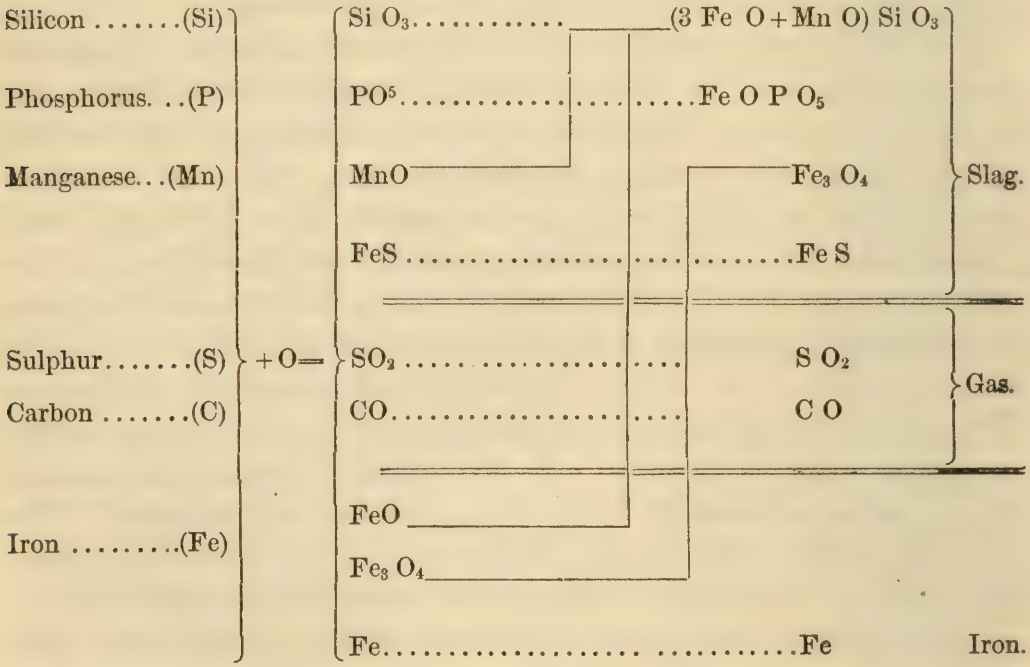
The next element is manganese. This oxydizes most readily, and for two reasons. First, its affinity for oxygen is originally very great; and, second, it has little or no affinity for the iron itself. All of the other elements combine readily with the iron, but maganese generally exists in it as an alloy, ready to leave it at the first breath of oxygen.

Moreover the oxyd of manganese forms a much more stable combination with silicic acid than does the oxyd of iron, and oxyd of manganese will always release oxyd of iron from the slag. Still again it requires only one equivalent of oxyd of manganese to satisfy one of silicic acid, whereas it requires three of iron to satisfy it; and hence, one atom of manganese will save in the slag three atoms of iron. So the atomic weights of both are about the same; one per cent of manganese saves about three per cent of iron, other things being equal. This element is of immense importance in metallurgy. It is highly detrimental to the quality of the finished metal, when retained in it. but as a part of the slag, and as a re-agent, it is most beneficial. It may be compared to certain drugs, which are extremely salutary and efficient as medicines, but deadly poisons when retained in the system.

The next element is sulphur. This presents many analogies to phosphorus in its behavior, but fortunately is not quite so tenacious in its affinity for iron. A portion of it is oxydized, and disappears in the form of sulphurous acid gas. The remainder, provided the process continue long enough, goes into the slag as sulphide of iron. This tendency is decidedly strengthened by the presence of manganese, which seems on all occasions to act as a healthful tonic, removing impurities by some hidden law not yet comprehended.

The last element is carbon. It is contained in larger proportions than any other, and is the one which determines the character and grade of the metal. So long as the carbon remains, so long does the metal preserve its character as cast-iron, and when the carbon is removed the wrought-iron properties are at once developed, even though other elements be present in considerable quantities. In the refining process it is the last element to leave the iron, and its departure gradually and surely changes its character and behavior. After the slag is formed the oxygen begins to attack powerfully the carbon. The combustion gives rise to carbonic oxyd (CO.), a gas which escapes through the chimney. In the puddling furnace the removal of the carbon is indicated by the boiling of the bath of metal. The iron ore, or other oxyd of iron, used to line the hearth of the furnace, freely gives up its oxygen to the carbon, which, in the gaseous form, escapes upward, occasioning a vigorous ebullition of the slag. This continues for a time, when a singular phenomenon takes place. Cast-iron is readily fusible in the reverberatory furnace, but wrought-iron not all so; or, conversely, the heat of the puddling furnace is above that of liquid cast and much below that of liquid wrought-iron. Consequently, as the changes progress, notwithstanding the constantly increasing heat, and as the iron becomes purer, it begins to show signs of infusibility. At length it reaches a state where it can nc longer remain fluid, and begins to segregate in granules and lumps out of the slag in a manner strongly suggestive of that in which butter separates from the buttermilk in the churn. At first it forms spongy, pasty masses, which weld together, gradually growing harder and more consistent as the process goes on. This is termed "coming to nature." The workman endeavors to retard the consolidation as much as practicable, because the reaction of the oxygen is impeded, and finally stopped by it, and it is important to subject the metal to its action so long as any impurity remains, which it is possible to remove. When the process is complete, the iron is removed from the slag and subjected to mechanical treatment, in order to express any remaining slag, and to condense the mass, and give it definite workable shapes.

Having thus briefly discussed the behavior of the various elements in the puddling process, we find that all the impurities are removable to a greater or less extent by oxydation. Let us then reduce our results to a kind of formula, which shall express in very general terms the reactions involved, as follows:



This may be interpreted as follows: If the six elements here given be subjected to the action of oxygen, the first five will be mostly oxydized, while the iron will be oxydized only to the extent of about ten or fifteen per cent, the residue remaining in the elementary or nearly pure condition. We may divide the products into three kinds: (1) slag, (2) gases, (3) iron. The gases are carried off through the chimney, the slag remains liquid and is tapped off, and the iron solidifies and is removed from the slag with tongs.

In the foregoing account of the conversion of crude into wrought-iron, it must not be supposed that we have lost sight of the Bessemer process. On the contrary, we have kept it continually in view, and the descriptions given and the reactions followed out are equally applicable to the Bessemer method. In a word, we have described the chemistry of the pneumatic process, as well as that of the puddling process. Each for each, the reagents are exactly the same, and their behavior almost identical, from the moment the metal is first touched by the oxygen until it receives its final shape in the shingling or the ingot mould. There is not a substance employed nor a combination induced or resolved in the Bessemer process which has not been repeatedly made use of for more than thirty years in the commonest practice of Europe and America. The differences, which are many and great, are all mechanical, and the Bessemer process may, with strict accuracy, be said to be the employment of entirely new mechanical methods and appliances for affecting old and familiar reactions. Let us proceed to the demonstration of these facts.

The gist of the Bessemer process lies in this: That the metal is kept fluid from the beginning to the end, from the time when the metal is first touched by the oxygen until it is finally cast into workable and definite shape in the ingot moulds. This implies an enormous increase of heat during the working, for wrought-iron is very doubtfully fusible in the most intense heat of the blast furnace, and not at all so in the reverberatory furnace. But in this method not only is the purified wrought-iron melted into a state of extreme fluidity, but it retains a surplus of heat sufficient to keep it liquid for a considerable time after it has received an admixture of five to ten per cent of cast-iron at less than half its temperature, and it can still be poured in a thin stream and cast with facility. Indeed no other process known to the arts develops a degree of heat at all comparable to this, and the most surprising thing connected with it is the simple and unexpected means by which it is obtained, of which more hereafter. The cast-iron intended for conversion is selected with reference to qualities, which will also be more fully described further on. Suffice it to say here that it must contain a large proportion of silicon, and be as free from phosphorus and sulphur as possible. It is first melted in a cupola furnace, whence it is run into the converting vessel. This vessel is hung upon trunnions, and through one trunnion receives an air-pipe, which passes down the side of the vessel to a chamber in the bottom. From this chamber the air passes into the main cavity of the converter through a hundred or more small passages called tuyere holes. The main cavity is lined a foot thick with highly refractory, siliceous material, and previous to the reception of the charge is heated as hot as practicable by burning soft coal in it. The charge of metal used in the converters at Troy, and generally elsewhere, is five tons, or 20,000 pounds, and the blast is forced at a pressure of twenty to thirty pounds. The vessel receives its charge in a nearly horizontal position, in order that the metal may not run through the tuyere holes at the bottom. When fully charged, the blast is turned on and the vessel righted, in which position the upward pressure of the blast prevents the escape of the iron. It is obvious that the blast cannot stop until the vessel has been again rotated, so that the tuyere holes are, so to speak, "out of water." The descent of the metal into the air-chamber is an accident from which every steel maker daily and devoutly prays to be delivered. At full heat the fluid charge would melt the iron bottom like butter, and display the contents of the converter over the floor in a fiery flood.

The blast being turned on, the reduction commences immediately. As in the puddling furnace, the first change is in the oxydation of iron and silicon. The silicon becomes silicic acid, and enough of the iron oxydizes to satisfy the affinities of the acid, and does not decompose during the remainder of the blast. It is during this stage of the process that the remarkable heat of the conversion is developed. It will be remembered that when silicon oxydizes it takes up three equivalents of oxygen. Carbon takes up only one in this process, becoming carbonic oxyd. It is a common error to suppose that any very great quantity of heat is generated by the combustion of the carbon; that is, as compared with that derived from the silicon. An elegant discussion of this point will be found in the November number of Van Nostrand's Magazine, vol. 1 (1869), translated by me from Le Genie Civil, being the remarks of a distinguished French metallurgist, M. Jordan, before the Society of Civil Engineers of France. The heat generated by the silicon burning to silicic acid will be found, by the application of the co-efficients and formulæ of the mechanical theory of heat, to be from two and one-half times to three times greater than that generated by the burning of the carbon to carbonic oxyd. Another circumstance of importance is, that the silicic acid remains a dense fluid in the converter, no part of its heat being lost, except such as is carried out of the converter by the atmospheric nitrogen, and none is rendered latent by converting it into vapor, while the carbon is vaporized, a physical change absorbing much heat, and the vapor thus formed is carried out of the converter at very high temperature. Hence will be seen the necessity of employing irons containing high per centages of silicon. At least two per cent of this element is essential, any less quantity being insufficient to generate heat enough to keep the iron thoroughly liquid and fluent until the end of the casting process. It is often asserted that irons for Bessemer conversion must be "grey irons," as they are called; that is, irons rich in carbon. Now, although this happens, as a rule, to be true enough, it is apt to lead to misapprehension. The fact that Bessemer pig-irons are carbonized varieties is an accident, and not an essential feature. What is essential is, that it should contain a large quantity of silicon and very little (indeed the least possible) of sulphur, phosphorus and manganese. Now, a pig-iron containing much silicon and no sulphur or manganese is pretty sure to contain a high per centage of carbon, as all smelters are aware. This fact is a feature of the blast furnace, and almost without exception. If an iron could be produced with much silicon, a little carbon, no phosphorous, it would, I think, be not altogether unsuited to the Bessemer treatment. In a word, the quantity of carbon is approximately immaterial, except so far as it implies proper conditions with respect to other elements. The main element required is the silicon, and not the carbon.

Of equal importance and absolute necessity is the absence of phosphorus. This element is the arch enemy of the iron maker, but it is the very scourge and pestilence of the steel maker. I venture to assert that the most formidable problem which has arisen with respect to any process dealing with iron or steel is the phosphorus problem in the Bessemer converter. A few pounds of phosphorus in a ton of Bessemer railway bars renders them unfit even for the scrap heap. Fifteen-hundredths of one per cent of it is sufficient to render common wrought-iron worthless, but one-tenth of that quantity will ruin Bessemer metal past all remedy. But the smallness of the quantity which is capable of working this terrible destruction is by no means the worst evil. There are two other circumstances of an appalling nature, viz.: The almost universal presence of phosphorus, and the absolute impossibility of eradicating it by any process at present known. "Chemical geologists" have very generally concluded that iron ores, with a few inconsiderable exceptions, are deposits effected by organic agency, of which the formation of bog ore, lake ore or linomite is a fair sample, and that the present conditions, as magnetites, hematites or spathic ores, are the results of metamorphic action the most highly metamorphic form being the magnetic oxyd. The manner in which beds of different oxyds are found to be related to each other tends strongly to this conclusion. For it is well known that phosphorus is an essential element to the growth of most organisms, and we must therefore anticipate that wherever organic life has wrought upon a large scale we shall find all the elements involved accumulate in its deposits. Hence it comes to pass that phosphorus is almost universally present in iron ore, in coal, and in those limestones which have been accumulated by the accretion of the skeletons and rests of animals. Owing to the enormous affinity of iron for phosphorus, all of the latter element contained in the fluxes, the fuel or the ore, is concentrated by the blast furnace process directly into the pig metal as phosphide of iron. I have already ventured the opinion that phosphorus increases its affinity for iron with every increase of heat; at least relatively, if not absolutely. This fact seems to be absolute. If we accept it we can instantly explain what seems otherwise to be many anomalies and contradictions. It will explain to us why, in the great heat of the blast furnace, it leaves every other combination and enters the iron; why, in the much lower heat of the puddling furnace, it seems to waver between staying with the iron or forming a new alliance with oxygen, ready to choose either, at the influence of any third substance which may affect the question; why, in the Bessemer process, it clings to the iron with a desperate tenacity which nothing seems able to resolve. These three facts, then, are all of them formidable. 1st. That a minute quantity of phosphorus is capable of working terrible injury, and that it is omnipresent throughout nature. 2d. That whatever quantities of it are charged into the blast furnace, as fuel, flux or ore, are almost wholly concentrated into the resulting pig iron; and 3d. That no portion is eliminated in the Bessemer converter. How, then, can we hope to make a metal which is good for anything?

Fortunately for our purpose, there are ores, fluxes, and fuels, which contain only extremely minute proportions of phosphorus, though I doubt whether there be any such materials absolutely free from it. But there are found those which are sufficiently so for all practical purposes. There is a limit below which even phosphorus ceases to be injurious to the metal, and hence we have no present alternative but to select those materials containing quantities of it within their limit. These furnace materials are somewhat rare, and confined to a few favorable localities; but their existence has been demonstrated fully in Europe, and I am sanguine that they can be found — nay, they are already found — in the United States.

You will perceive, then, the force of the remark, that the question of the practicability of making Bessemer metal resolves itself, first and foremost, into the question of the practicability of making a suitable pig-iron for it. To settle this, we must go back to the blast furnace, and, even back of that, to the ore-beds themselves; and, hence, it will not be going beyond the limits of our subject to discuss some features of this antecedent question. The Bessemer process will be seen to mean, not merely circumstances attending the forcing of air through a bath of molten metal, but the selection of suitable materials, and smelting them in the blast furnace. But, before doing this, let us continue the discussion of these reactions, and get them out of the way, in the hope that, from the end of the process, we may, by looking backward, determine intelligently what materials we are to look for, and how we are to treat them.

One more point with reference to the behavior of phosphorus. I have maintained that its failure to be removed is due to its originally powerful affinity for iron, which is strengthened by the enormous heat of the pneumatic process. But iron is not the only metal for which its affinity is very great. The metallic bases, sodium and potassium, oxydized to soda or potassa, have great affinity for acids. They readily form silicates, and, still more readily, phosphates. Traces of these elements are frequently found in pig-irons, and notably so in the charcoal irons. They reappear, too, in the slags derived from converting charcoal irons in the puddling furnace. They are unquestionably derived from the ash of the charcoal, which contains them in notable quantities; and these facts have led to the conjecture, frequently expressed by metallurgists, that the superior qualities of charcoal irons are due to these bases, which take up both phosphorus and sulphur, as well as other noxious impurities, in the form of acids. The well-known affinities of these bases for phosphoric acids led Girard to believe that, by introducing the vapor of sodium into the iron previous to its treatment in the converter, phosphate of soda or potassa might be formed, and phosphorus thus eliminated. This conjecture is by no means impossible, though it holds out very little hope of practicability, since it would, of necessity, be an expensive resource. It is merely mentioned, as indicating a possible direction, toward which we may, perhaps, sometime, turn for assistance.

Manganese, which is so beneficial in the puddling process, has both advantages and disadvantages in the Bessemer. I do not refer here to the manganese contained in the spiegeleisen, which is another matter, but to the manganese sometimes contained in the convertible metal. An excessive quantity, while forming an excellent slag, economizing iron, and removing sulphur, will deteriorate the quality of the steel itself, and sometimes interferes with the regularity of the process. From one to one and a half per cent is, on the whole, very beneficial. It is powerfully oxydized in the first stages of the conversion, and replaces iron in the slag, rendering the slag very liquid and fusible.

With respect to sulphur, the reactions in the Bessemer converter, do not differ from those of the puddling furnace. It is removed chiefly about the middle of the heat. Although no careful and systematic analyses of the slag have yet been made, it is probable that sulphide of iron will be found there in small quantities, provided the pig metal contain it to the extent of two or three per cent. It is, by all means desirable, that the pig should be as free from sulphur as from phosphorus. Its effects are always deleterious, although it requires a larger amount of sulphur, than of phosphorus, to cause an equal amount of damage. Like phosphorus, too, it is one of the universally-diffused elements, accumulated by organic agency, and much more abundantly in fuel than in ores. But sulphur is on the whole, not a very formidable difficulty, because it can be sufficiently removed from most irons. A small quantity of manganese, is its best antidote, with which it readily combines as a sulphide, with a stronger affinity than for iron. The oxydation of the carbon is the final reaction of the blast. It begins before the silicon is removed, and continues with increasing vehemence, until two-thirds or three-fourths of the time has elapsed, when it begins to show signs of exhaustion. The product, is carbonic oxyd, with possibly a slight admixture of carbonic acid. The silicon stage, very considerably overlaps the carbon stage; indeed, when the percentage of silicon is very high, it continues to oxydize in decreasing quantity to the end.

The moment for terminating the blast is indicated, usually, with extreme promptness. The flame from the mouth of the converter, is the outward sign of what transpires within, and to the accustomed eye, and even the accustomed ear, it may be said, gives unerring indications of its progress and completion. It begins, very tamely, by the emission of a thin, transparent, and not very intense luminosity, showing that very few volatile matters come out. Indeed, the oxydation being at first confined to iron and silicon, which are non-volatile, it is precisely what would be expected. But when the carbon begins to burn, as it does, very gradually, the flame becomes by degrees more brilliant, whiter, denser, longer, and more voluminous, passing from orange or yellowish-white, to nearly pure white, and ultimately to violet white. Near the end, it grows somewhat paler, and somewhat less voluminous, until the theoretical moment is reached. Then, with great suddenness, a marked change takes place. The flame becomes instantly smaller, and clearly transparent; indeed, somewhat hollow and ghostly, accompanied with a smoke, which, except in special cases, was not before very perceptible. The great feature, however, is the suddenness of the change. Some idea of its rapid character may be gained, when it is stated that the practiced, and not very highly practiced, observer, can discern it in the night time, at a long distance from the foundery, and in any position where he can command view of the tall chimney, or even of the glare from the doorways, no direct view of the flame being necessary.

What is most remarkable is, that this change takes place before the carbon is perfectly removed. There is still left in the bath a minute quantity of it, which seems to decline further oxydation. It is exceedingly small, indeed not more than five or eight hundredths per cent, and sometimes is considerably less. Now it is generally supposed that the flame owes its intensity to the combustion of the carbonic oxyd, and the presence of other matters included in it. Moreover, the oxydation and removal is a gradual one, and what possible cause can we assign for this almost instantaneous change? If the blast be continued after it, its affect is merely to oxydize the iron and not the small residues of impurities. Indeed, none of the impurities are removed perfectly, but seem to resolve themselves slowly, and with decreasing rapidity, until a certain point of attenuation is reached, when further resolution is overpowered by a direct oxydation of the iron. Now, why should their removal be suddenly chopped off short in this way, or at a point of decarburization which is nearly, but not quite, perfected? The explanation of this, which I suggest, I have not had time to consider fully, but at present it seems to me to approximate to correctness, though I do not offer it with the fullest confidence. You will be best able to comprehend it by a black-board illustration. [The speaker here illustrated the intensities of the reactions and their succession by two co-ordinate axes and curved lines referring to them.] A plausible explanation is this: When two combustibles are intermixed, like oxygen and hydrogen, or hydrocarbon gas, it is well known that the relative proportion of the two elements in the mixture influences the readiness with which they combine. Thus oxygen and hydrogen cannot combine explosively, unless their proportions lie within certain definite and rather narrow limits. May not the same law hold good in the present case? It is certain, or nearly certain, that the iron either does not oxydize in the bath during the blow, except in quantity sufficient to furnish a base for the acids present, or, if it oxydizes beyond that, it is immediately reduced again, leaving little or no free oxyd of iron in the bath. But after the change of flame all this is reversed, and iron oxydizes rapidly and freely, and remains undecomposed, while the residual traces of the other elements as suddenly cease to oxydize rapidly. I freely grant that in referring this back to what is supposed to be a conceded, but unexplained law, we are merely putting the question in another, a more general and more abstract shape, still it is, in a qualified sense, an explanation.

At the termination of the blow we have wrought-iron in a thinly fluid condition, and though still retaining traces of impurities, yet much more free from them than the iron obtained by puddling. Now it is popularly understood that the Bessemer process is a process for making steel; and the term steel is almost always used after the adjective Bessemer, in speaking of the resulting metal. After considering the matter fully, I do not hesitate to say that the term steel, as applied to any Bessemer metal produced in this country, is an entire misnomer, as you yourselves will soon be able to decide. It is true wrought-iron possesses, however, in an incipient degree (and a very small degree), the properties of steel. But let us first complete the process.

After the iron is blown, it is covered by a slag, which, on account of the large amount of silicon eliminated, contains much oxyd of iron. There is also some free oxyd of iron in the bath, which is produced because some seconds generally or always elapse between the change of flame and the stoppage of the blast, and in that interval enough of oxyd of iron is formed to injure the quality of the metal. Again, some free atmospheric oxygen is also contained in small bubbles in the bath, which would give rise to small flaws in subsequent working. Finally, the sulphur, if any considerable quantity existed in the pig, is insufficiently removed by oxydation. In making railway iron, it is also necessary to add a small quantity of carbon, in order to render the metal harder than the almost pure iron yielded by the blast. In a word, the metal needs a treatment which shall remove oxygen and add carbon. This is effected by introducing into the converter a small quantity of melted cast iron of a peculiar constitution. The deoxydization is best effected by manganese, since it will instantly absorb free oxygen and decompose oxyd of iron. The oxyd of manganese thus formed will immediately decompose the silicate of iron, which is the slag, eliminating part of the iron in the metallic state, and forming silicate of manganese. There is also no danger of the manganese alloying with iron, or mingling with it to any injurious extent. It also tends to eliminate still further any sulphur which may still remain. The whole range of chemical technology does not furnish a more perfect specific for any purpose than manganese at this stage of the process. The peculiar form of pig-iron known as spiegeleisen contains from four per cent upward of manganese. It is a property, too, of all spiegeleisens, that they contain the highest percentages of carbon, and hence it is the very metal we are in quest of as a deoxydizer and a re-carburizer. The higher the percentage of manganese, the better; because it enables us to employ smaller quantities of it, and thus partially avoid introducing silicon, sulphur, and other deleterious matters, always contained in spiegeleisen more largely even than in common cast-iron. The quantity of spiegel turned into the converter for ordinary railway bars is, at Troy, five or six per cent of the main charge. This contains five per cent of carbon, and thence the amount of carbon added is from twenty-five to thirty-hundredths of one per cent. But of this carbon a portion is oxydized by the oxyd of iron in the bath, so that the whole amount remaining does not exceed twenty-hundredths of one per cent. This amount of added carbon is not sufficient to constitute steel, in the ordinary acceptation of the term, although it is sufficient to develop to some extent the steel properties. Indeed, for railway purposes, a true steel is wholly undesirable. Those who are acquainted with properties of chalybeate metals, in their relations to the arts, will bear out the assertion that a genuine steel is totally unfit for any such purpose. There is a vast amount of popular ignorance and misapprehension on this subject, not a little so-called expert, and even some scientific misunderstanding. It is generally believed that genuine steel is the best possible metal to resist stresses of all kinds, and that the Bessemer process yields very bad steel. But, in fact, steel is wholly unsuited for many kinds of stress; the Bessamer process, as practiced in this country, does not yield a steel at all, and the metal which it does yield is not bad, but of the highest excellence. Now let us briefly scan this matter, and see if, in all reason and in fact, it be not strictly true. I have labored throughout this paper to show you that the differences between the puddling and Bessemer processes are not very—indeed, are only slightly—different in their chemical relations; but that they are widely asunder in their mechanical elements. When wrought-iron comes to mature in the puddling furnace, it aggregates into a sponge, or loosely conglomerated granules of iron, without any special arrangement, and including in its porosities considerable scoriaceous slag, which is partially expressed by powerful squeezing. But every atom and every lump of iron is bathed in this slag, which cannot be all removed, and the utmost that the squeezing can do is to remove a part, and force only a portion of the particles into strict mechanical contact. But even the metal itself is not thoroughly homogeneous, and cannot be homogeneous with such a clumsy method of working as is now followed, by stirring with a rabble. The bar or billet made from the puddle ball is cut, in subsequent processes, into numerous pieces, which are piled and welded together by rolling. Now what is the result? Even in the best iron the finished product is a mass of welds, united as best they can be, but still welded together, with all the uncertainties and imperfections which necessarily attend welding. Now it is clear (I quote the language of Mr. Bessemer) "that iron in its ordinary malleable state presents an unfavorable contrast to the other malleable metals; for they are known not to possess the inequalities found in iron; they are free from sand and scoria, and have no hard and soft parts, nor do they require any welding of contiguous surfaces, but are perfectly homogeneous and free from all mechanical admixtures with foreign substances. To what, then, do gold, silver, copper, zinc, tin and lead owe this valuable exemption from the defects universally found in puddled iron? The answer is found in the simple fact that all these metals are purified and refined in a fluid state, and while still fluid they are formed into ingots." By this process any impurities float on the surface of the metal, and are effectually separated from it. And this is just what the Bessemer process accomplishes for wrought-iron. It makes a perfectly homogeneous metal, free from included slag, and all its particles in thorough contact. The gist of the whole process is, that it enables us to make a cast wrought iron.

"The ingot, of whatever metal it is formed, crystallizes in cooling, in a manner peculiar to itself, all cast ingots being of crystalline structure." This crystalline property, by many observers, has been seized upon, and declared to be an inherent vice. It is the strangest thing possible, that it has not also been noted, that the same property is chargeable in ten-fold degree, upon puddled iron. It would be impossible to illustrate this any better, than by mentioning an experiment, made over a year ago, at Fort Monroe. It was a trial of a fifteen inch gun, and twelve inch rifle, against an iron and granite target. In constructing the target, there were used, wrought-iron stanchions, supporting the framework, to which the plating was bolted. They were of enormous size (12x15), and at the first impact, one of them broke across, like glass. When the surfaces of fracture were exposed, they caused an exclamation of wonder from every expert and manufacturer who saw them. It seemed as if the mass were composed of large crystals; larger, indeed, than those of any cast-iron, except spiegel, and of brilliant lustre. Thinking that it might be due to the suddenness of the impact, two of these beams were broken in a hydrostatic press, and showed about the same state of affairs. Somebody suggested that they were badly made, but they were manufactured out of the best charcoal pig, from Lake Superior ores, the best iron to be had for the purpose, by the Sligo Iron Company, whose iron commands, in the market, a higher price than any brand in the civilized world. It was finally suggested to be an anomaly, but the upshot of it was, they came to the conclusion that pretty nearly all large forgings exhibited the same phenomena, and the mystery is, that so obvious a fact, so thoroughly established, and so well known to Bessemer men, had ever failed of recognition, And yet this crystalline property, does not lessen ductility, in any degree, whatever, as has been proven over and over again, both in Bessemer and puddled metal. The contrary notion is a mere tradition, and a prejudice. which none but true experts ever conquer. Why then, should it be urged, that the only way to make iron, is to stick dirty granules of it, imperfectly together, and squeeze the mass until it is almost useless, until it is fagotted together, and again united imperfectly, and thus, forever, repeat injuries and defects, entailed by the first process, when it may be cast into a ductile homogeneous ingot, and forged into any size or shape, at will.

I regret that I am obliged to leave the subject here, with many important features untouched. But these may well form separate theses by themselves, though they form, together, a united branch of technology, which is one and indivisible in reality. Let me close, therefore, with a definition of my theme, that the Bessemer process is a method of making cast wrought-iron.

ON IMPROVEMENTS IN INLAND NAVIGATION.

By SAMUEL D. TILLMAN, LL. D., of Jersey City, N. J. Read before the American Association for the Advancement of Science at the Troy meeting, August, 1870.

The canals and navigable rivers in the territory of the United States form a network of transit, unrivaled in extent and importance. In the State of New York alone, the artificial water channels of communication have a total length of nearly 1,000 miles, of which 893 miles belong to the State. The connection, with rivers and small lakes make the whole distance now navigated by New York canal boats about 1,350 miles. On the twenty canals owned by the State are 565 stone locks, which, if placed in a continuous line, would extend nearly seventeen miles; and the bridges over these canals, if placed end to end would form a line of equal length. The Erie canal, seventy feet wide and seven feet deep, is carried over several rivers and large streams on stone aqueducts of unequaled magnitude. Some idea may be formed of the business done on the New York canals by the following official statements:

From 1859 to 1866, inclusive, 12,850 canal boats were built and registered, having a carrying capacity of 1,291,497 tons. During these years the aggregate movement on all the canals amounted to 39,433,625 tons. For twenty years preceeding 1867 the tolls collected amounted to $65,815,411; the yearly average being $3,090,770. After deducting the cost of maintenance, the average annual surplus revenue from the canals was found to exceed $2,319,500. From 1854 to 1865, inclusive, the average freight paid for moving one ton one mile on the canals, was nine mills and one-tenth of a mill, while the average freight paid during the same time for moving one ton one mile on the New York Central and Erie railroads, was $2\frac{41}{100}$ cents, showing that during those years the cost of transportation on railways was nearly three times greater than that on our canals. Boats carrying 220 tons burden are now used on the Erie canal; the enlarged locks being eighteen feet wide and 110 feet long between the quoins. The boats are mostly moved by animal power, at a cost of thirty-eight cents each per mile, except on the rivers and lakes, where they are taken in tow by steamboats. The average speed of canal boats of the largest class moved by horses does not exceed two miles an hour, and as only three horses can be employed with advantage to each boat, it follows that any further increase on the size of canal boats would involve a corresponding decrease in speed when moved by animal power. According to the able report for 1869 by the Hon. Van R. Richmond, New York State Engineer and Surveyor, the resistance to be overcome in moving a loaded canal boat at a speed of two miles per hour, calculated from Dubuat's formula, as modified by D'Aubisson, is 428 pounds. The force required to develop the standard value of a horse-power at two miles per hour is 187½ pounds; deducting one-sixth for oblique action, leaves the force exerted in the direction of the boat's motion equal to 156¼ pounds. From experiments made in France in towing barges on the Languedoc canal, it was found that ordinary horses exerted an average effort of 143½ pounds for six consecutive days, at a speed of two miles per hour. Consequently an Erie canal boat, which partakes of the general build of the Languedoc barges, would require three horses to move it at the rate of two miles per hour. The resistance of a vessel varies as the square of its speed, and the power to move it varies as the cube of its speed. This law seems to have been overlooked by some of those who have attempted to move canal boats at comparatively high speed by means of steam power. They have recognized the truth of only part of the proposition, namely, that the resistance varies as the square of the speed; that is to say, if a boat requires eight horses to overcome the resistance at four miles an hour, to double its speed would require four times eight or thirty-two horses; yet it is evident that this power must be applied while the boat is moving double the distance first made, therefore the number thirty-two must be doubled, which gives sixty-four horses as the measure of power required to move the boat at the rate of eight miles per hour. This law, however, cannot be strictly true for all forms of vessels, and in navigating canals there are other conditions which modify the result, as, for instance, the wave of displacement, which, rising high in shallow water, would seriously impede a vessel; but were its form so improved as to allow the water to close in when only one-third of her length had passed, and were its speed at the same time increased to a certain point, this wave of displacement would be brought into such relative position that it would no longer impede the vessel. However, the carrying capacity of a canal boat being paramount, its form must not be modified so as to favor increased speed; thus with this class of vessels the law will still hold good, to double the velocity the propelling power must be increased eight-fold. If a loaded canal boat is moved at the rate of two miles an hour with three horses, and at the rate of four miles an hour with twenty-four horses, the obvious deduction is that it is impracticable to move such boats by horse-haulage at the rate of three miles per hour, and quite as impracticable to move them by steam power at a speed greater than four miles an hour.

The plan of moving several canal boats by one steam-tug is objectionable, because the whole moving power is concentrated at one place, and acts upon a very limited quantity of water. The same power divided into four equal amounts, and acting on four times the quantity of water would be more effective. Such boats are most liable to delays, and are utterly helpless when detached from the steam-tug.

The successful navigation of canals seems to me to depend on the following conditions:

1. Each boat should be automatic, that is to say, self-propelling.

2. The build of the boat should be such as to give it the greatest carrying capacity.

3. To economize space and power, the boiler and engine should be small, and capable of moving the boat, when loaded, at an average speed of three miles an hour. This rate is about double the present average of loaded boats.

4. The propelling power should act directly against the water, and not against the bottom or sides of the canal.

5. If we turn to nature for lessons in propelling, we observe that the slow-moving fish of our fresh-water streams have broad tails bounded by a nearly vertical line; while those remarkable for speed have V-shaped tails, the extremities of which are capable of very quick motion. Applying this principle to slow-moving boats we infer that a quick motion is not so essential as a large area of propelling surface.

6. The width of the boat and its draft should only limit the quantity of water against which the propelling surface should act.

7. The boat should be made more obedient to the helm by enlarging the rudder surfaces, and arranging them so as to act on shallow water more efficiently than by the common method. The most important of these conditions would be fulfilled by building the boat with four sterns, and placing behind each a propeller; or by giving the boat a scow-shaped stern, and arranging in one line behind it four screw propellers, placed nearly as deep in the water as the bottom of the boat, from which would project iron bars for their protection The locks being eighteen feet wide, the propeller blades could be nearly four feet six inches in diameter, and whether the boat were light or loaded these propellers would act on the water under the best possible conditions. Behind each of these propellers should be placed a balanced rudder, which under these conditions, could be made one-fourth lighter than usual; and the tiller of each should be connected by a movable joint with one bar extending nearly across the boat, behind which the steersman could guide the boat by only exerting strength sufficient to overcome the friction of the apparatus.

A boat embracing the improvements here suggested has not yet been constructed, but from careful estimates based on reliable data, I feel warranted in saying that such a boat, when loaded, could be moved at a speed of three miles an hour, with an expenditure not exceeding that now incurred in towing a similarly loaded boat at the rate of two miles an hour by means of horses. The saving thus effected would be between one and two million dollars per annum, on the present business of the canal. A large portion of the carrying trade has been diverted from the canals, solely on account of the time consumed in transportation. We may reasonably infer that an acceleration of speed of about fifty per cent would greatly increase the amount of goods transported by these cheap modes of conveyance, and thus correspondingly increase the revenue which the State derives from its canals.

ON PROPOSED IMPROVEMENTS FOR COMMON ROADS.

By Prof. S. D. TILLMAN, American Institute, New York. Read before the American Association for the Advancement of Science, at the Troy meeting, 1870.

If durability be the most essential quality in a good road, the ancient Romans excelled in the art of road making. Of the twelve famous highways leading into their capital, vestiges of which are still to be seen, the Appian way was the oldest. Originally its length was 142 miles; at a later period it was extended to 380. It consisted of large blocks of smooth stone, accurately fitted together, for the use of carriages, and a foot pavement on each side two feet wide. A part of the Tiburtine road, near Tivoli, still remains undisturbed, having been in use more than 2,000 years. One of the most remarkable roads of which we have any account was that leading from Quito to Cuzco, built by the ancient Incas of Peru, 900 miles long and seventy-five feet wide. According to Prescott, the historian, "it was conducted over pathless sierras, covered with snow; galleries were cut for leagues through living rock; rivers were crossed by means of bridges suspended in the air; precipices were scaled by stairways hewn out of the natural bed; and ravines of hideous depth were filled up with solid masonry."

However much we may admire the massiveness and permanency of ancient roads, when estimated by the modern standard of utility, such structures are found not to meet the requirements of this practical age. Modern engineering has demonstrated that speed, certainty and safety are the three great requisites of intercommunication. An absolute and complete change in the means of traveling has been wrought by the introduction of the railway and the locomotive. One has given us a perfectly smooth and solid pathway of easy grade, its great economy being in its reduction to such narrow width as to sustain only two wheels, which are kept securely thereon by means of flanges; the other has provided a moving power ever ready and reliable, untiring in its energies and matchless in its speed. The change thus wrought in our own country, where the railway system is far more extensive than in any other, was more marked, because the ordinary roads had not been much improved, and were in a condition similar to those of England a hundred years before. The once famous turnpike extending from Albany to Buffalo, over 100 feet in width, had been covered, throughout its middle section, more than once, with broken stone, which, by the action of rain and frost, disappeared beneath the rich soil. Only forty years have elapsed since numerous stage-coaches were running over this turnpike, making, during summer and winter, an average speed of eight or ten miles an hour, while in the spring and fall it did not equal that of the passenger boats on the Erie canal.

Previous to the introduction of the railway, numerous experiments were made for the purpose of improving the common highways, and more especially the pavements of cities and large towns. Of stone pavements, the cheapest and most objectionable is the cobble-stone; superior to this is the Belgian pavement, which consists of rough stone cubes imbedded in sand. The most durable and costly, yet, in the end, cheapest stone pavement, consists of stone blocks, about three inches thick and twelve inches square, set on end, with their broadest faces in contact, and resting on a bed of concrete, like that now on Broadway, in the city of New York. Professor Mahan, in his essay on "Road-making," states that asphaltic pavements — consisting of bitumen and sand — and wooden pavements, have been extensively used in Europe, but seem not to have answered the desired purpose. The most popular pavement in this country at present is made of wooden blocks, resting on a wooden foundation covered with bitumen, and separated from each other by means of a thin partition of bitumen and gravel. The ease with which the horse travels on this pavement, and the almost entire absence of noise, are strong points in its favor. The question of its durability on much-traveled thoroughfares has not yet been definitely settled. Roads made on the plans of Macadam and Telford are not used in the business streets of American cities, on account of the fine grit and dust resulting from the action of horse-shoes and wheel-tires. It is needless to say, none of the plans alluded to fulfill all the conditions of a perfect pavement, since none of them embrace the admirable peculiarity of the railway, in providing for the wheel a perfectly smooth pathway. Obviously the smooth, solid surface, on which great speed is attained by means of the locomotive, would, on the common highway, result in somewhat increased speed, with a great decrease in the power required to produce that speed. In other words, all loads could be transported more rapidly by employing not over one-third the number of horses now used to do the same work, and with far less wear and tear. To illustrate this point, let us take the most perfect pavement, that already alluded to on Broadway, where a pair of horses attached to an omnibus draws less than one-fourth the load drawn by a pair of horses attached to a street railway car. Each of the wheels of an omnibus, in passing from one stone, falls slightly, and raises as much by sudden contact with another. Thus a series of concussions is made by each wheel, which jerk the horses, jolt the passengers, and jar the vehicle. The number of noisy concussions thus made by an omnibus, in passing over one mile on the Broadway pavement, is about 63,000, and in one day's travel, of thirty miles, is 1,890,000.

It may be asserted with truth that the concussions are not so great on wooden pavement, as is proved by the absence of noise. This result is owing to the fact that wood is more elastic than stone, and gives way slightly under pressure. Yet in this fact lies the proof that a loaded wagon can be drawn with less effort over a good stone pavement than over one of wood, which will be apparent, if we reflect that the wheel, by its great pressure on the wood, is constantly sinking slightly below the general surface, and thus constantly forming an impediment before it which must be overcome. When the wood is wet the sinking of the wheel is perceptibly increased. According to the experiments made by Sir John Macneill to determine the force of traction for one ton on level roads, it was found that on a gravel road the force is 147 pounds; on a broken stone surface, laid on an old flint road, sixty-five pounds; on a broken stone road, covering a rough stone pavement bottom, forty-six pounds; on a good stone pavement, thirty-three pounds. To this it may be added that the force on a railway is eight pounds. In other words, that one horse will draw on a railway more than four can on a good stone pavement. Nicholas Wood, in his treatise on railways, estimates the force of traction for one ton on a smooth turnpike road at seventy-three pounds, and on railways at eight and a half pounds. That is to say, two horses will draw more on a railway than seventeen horses can on an English turnpike.

The important problem now presented is to construct city pavements so as to embrace the essential features of the railway. Its successful solution depends on the following conditions:

1st. To form a solid and virtually smooth surface of an unyielding material, on which the carriage wheels may roll.

2d. To provide a foothold for horses in passing over such surface.

If the material used for this purpose is stone, in small blocks, we find by experience that when laid with the utmost care there is always a space left between these blocks, over which the wheels must roll, and in passing from a stone the wheel strikes the next with a blow proportionate to the load it sustains, the effect of which is to wear off the edge of the stone; and the wheel passing in an opposite direction wears off the opposite edge, so that the space between the stones is gradually widened, thereby increasing the force of the blow by the wheel. Thus the stone in time becomes rounded on two sides, and in that form is hardly more efficient than cobble stones.

If the material employed were iron it might be cast in hollow blocks so as to be interlocked, and its face could be provided with a series of smooth raised surfaces, alternating with depressions or indentations; and the raised surfaces could be so arranged that the wheel would be constantly sustained on a true grade by rolling over one raised surface, which should touch the middle of the tire, or by rolling over two raised surfaces which, either simultaneously or alternately, would give a bearing to the wheel tire near its sides. The transverse depressions thus formed allow the toe cork, or fore part of a horse shoe, to sink below the raised or grade surface, and by means of such surfaces the horse would find a sufficient bearing against which to exert the leverage of his foot.

Cast-iron blocks thus made might cover the whole surface of a street; but as the cost of such a pavement would be a serious obstacle to its general adoption and use, the more feasible plan is to provide an iron pathway or tramway for each wheel of the vehicle, and fill in the spaces between such iron pathways with either stone, wood, or asphaltic composition, thus providing a pathway for the horse. A pair of iron paths, each about one foot wide and placed four feet and a third apart, would provide a tramway suitable for vehicles of various widths, embracing the pleasure carriage, cart, lumber wagon and omnibus, and a pathway for a pair of horses between such tracks. The tramway could be made of hollow cast-iron blocks, each about a foot long, with a projection on one end and a recess on the other, so that when brought together and interlocked, the pressure on the edge of one block would be transferred to the center of the next. Such blocks could be laid directly on pure sand, or be filled in from beneath with wood and laid on a perfectly solid and smooth foundation. The tramway could also be constructed of longer wrought-iron or cast-iron plates, having longitudinal ribs or webs underneath to strengthen them, each resting securely, by means of spikes, on one-half of the top of a wooden post set in the ground and reaching below the action of frost. This plan would give a permanent pathway for the wheel, independent of that for the horse, and also would be unaffected by any changes which the surrounding earth might undergo by the action of water or frost. The face of such tramway could be composed of alternating smooth elevations and depressions, of a series of narrow ribs running longitudinally, or of a smooth surface, having on it one or more lines of elevations and depressions, so arranged as to provide a foothold for horses, and when placed on the edges of the tramway, to allow wheels to pass obliquely over it without sliding.

A single pair of iron wheel-paths of this description, placed in the middle of a street not much used, would accommodate all carriages which, in this case, would have to turn off from the track in passing each other. In a more busy street, two pairs of tramways would accommodate carriages going in opposite directions. In still more crowded streets four pairs of tramways could be laid down, two for loaded teams moving slowly in opposite directions and two for carriages moving more rapidly in opposite directions, and on great central thoroughfares, like Broadway in the city of New York, my plan is to lay down longitudinal iron paths, from six to nine inches in width, alternating with a stone, wood or asphaltic footway for a single horse, about two feet in width; so as to fill up the whole width of the street with alternate wheel-ways and horse-ways. It need hardly be added that such tramways would make the steam carriage practicable.

Such, briefly stated, are the main features of the iron tramway system, which, if introduced on common roads, would add to the comforts of the pleasure carriage, save the wear of vehicles, make every horse four times as efficient, and, in fine, work a revolution more radical and beneficial than that which followed the introduction of the railway.

October 20th, 1870.

Prof. S. D. Tillman, in the chair; Robert Weir, Esq., Secretary.

After calling the meeting to order, the Chairman read the following notes of scientific progress:

OXYGEN GAS PREPARED AT THE ORDINARY TEMPERATURE.

Prof. Boettger states, that when a mixture is made of equal weights of the peroxyds of lead and barium, and dilute nitric acid of a strength of 9°, Baumé, is poured thereon, a current of pure oxygen gas, free from ozone and antozone, is given off abundantly. This mixture of the two peroxyds, may be kept dry in a stopped bottle for any length of time.

A CURE FOR SOMNAMBULISM.

Two instances of somnambulism being perfectly cured by means of bromide of potassium, are recorded in the Paris *Les Mondes.* A woman twenty-four years old, who had attacks two or three times a week for ten years, after taking two grammes of bromide of potassium in seventy-five of water, daily, the dose being gradually increased to six grammes, was entirely cured at the end of two months. The other case, a girl of eight years, after taking one gramme, morning and evening, for a short time, was completely restored to health.

The President remarked, that bromide of potassium is a favorite remedy for other diseases of the brain.

MAGIC LANTERN PICTURES BY A NEW METHOD.

Mr. Shepherd Holman, of the Franklin Institute, Philadelphia, has devised the following method of preparing pictures for the magic lantern. A sheet of gelatine, such as is used for tracing, is securely fixed over an engraving, and with a sharp steel point (made by grinding down the end of a small round file) the lines of the original are traced pretty deeply on the transparent substance. Lead pencil or crayon dust, is then lightly rubbed in with the finger, and the picture is at once ready for use. The effect of these drawings in the lantern, is said to be excellent.

ISINGLASS.

J. L. Souberaine, who has recently examined the different varieties of this article, points out these distinctions: Russian isinglass dissolves very rapidly in hot water, seldom leaving over two per cent of insoluble residue; it is pleasant to the taste, and yields a firm and transparent gelatine. Bengal or Indian isinglass, dissolves readily, but leaves a much larger proportion of residue, from seven to thirteen per cent; it often has a fishy taste, and its gelatine is not clear. The gelatine obtained from Brazilian isinglass, is opaque and acrid. The isinglass prepared in China is seldom exported.

COPAL.

This resin, when in large pieces, commands high prices, even in those parts of Africa, where found. The recent and fossil copal, may be easily distinguished by the mottled surface, which is always one of its characteristics. Like amber, the fossil gum often incloses flowers and insects in a perfect state of preservation. Captain Grant has explained the cause of its production; the true copal gum-tree, is a climber, running to great heights among the forest trees. It sometimes becomes completely separated from its original root, and the copal exudes from these detached roots.

Dr. D. D. Parmelee.—During the war, copal became very scarce, and rose to three times its former price. At Salem, Massachusetts, there was a pier where vessels had long discharged their cargoes of copal. Some gentlemen conceived the idea of examining the "filling in" of that pier, and discovered that there was a considerable amount of copal there. Upon excavating, they realized the enormous profit of, I think, $15,000, which, otherwise, never would have been thought of. It is an illustration of the waste constantly going on, which we do not notice until necessity impels us to search for a supply.

Professor J. A. Whitney.—In attempting, some years ago, to dissolve copal in alcohol and turpentine, I found that leaving it in the sunlight, after some months, it dissolved in a kind of pasty mass. Whether it could be used or not, I cannot say; but such facts are sometimes germs of discovery, though oftener leading to nothing.

Dr. Parmelee.—This announcement is important. It has been heretofore discovered, that on heating copal it could be afterwards dissolved readily.

The President.—Probably in this case the heat of the sun's rays produced the effect.

Professor J. A. Whitney.—Probably; but I suppose it never exceeded 95°.

BLACK COATING FOR ZINC ORNAMENTS.

Dingler's Polytechnic Journal states that M. Neumann has instituted a series of experiments to point out the best material to produce upon statuary or ornamental objects made of zinc, a pleasing blackish coating, without impairing the effect of the natural color of the metal, as would be the case, when an oil paint or varnish is used. The best results were obtained, when nitrate of protoxyd of manganese was employed. This salt, on being heated, is decomposed, yielding black peroxyd of manganese, and the degree of heat required is not so high as to affect the zinc. The best solution for this purpose, is fifty-four grammes of the salt, in one litre of water.

A PHOTOGRAPHIC NOVELTY.

M. Basin claims to have made a curious discovery. By admitting colored light, which does not pass through the lens of the camera, he alleges that the picture is favorably modified; its blacks and high lights are much softened, and the half tones greatly improved. His method consists in making four holes in the front of the camera, and fitting into them glass colored by a solution of carmine and ammonia, behind which is placed another piece of unpolished glass. These holes are uncovered at the same time as the lens, so that the red light falls upon the plate simultaneously with the image from the lens. The same effect is said to be produced if the sensitized plate be exposed to red light, either before or after the picture is taken. As the picture is known to be solely the effect of actinic rays, it does not seem plain how rays almost entirely devoid of actinism, like the red, can produce the results reported.

The President.—I doubt very much whether he does what he supposes he can do.

COLOR OF FLOWERS CHANGED BY AMMONIA.

M. Vogel, of Munich, Germany, has published the result of his experiments on the changes produced in some vegetable colors, especially those of flowers, by ammonia, the lengths of time of exposure being a quarter of an hour, two hours and twelve hours. The change produced in the color of some flowers, such as the rose and phlox, by the fumes of tobacco, is entirely due to the ammonia which it contains. The yellows, dark violets and reds remained unchanged by the lengthened exposure to ammonia, excepting the red of the zinnia, which is converted into a brown-red. Blue is sometimes unaltered, sometimes converted to a dirty green, and then bleached. The changes are generally the same as those that take place during the withering of the flower. M. Vogel thinks that these observations may be of practical importance in the manufacture of vegetable coloring matters, like the aniline dyes.

ON THE CHANGE IN THE RADIATION OF HEAT BY ROUGHNESS OF SURFACE.

One of the last papers by the late Prof. Magnus had the above title, and was published in a Berlin scientific journal. It is one of great importance in some branch of art, and we shall give as full a summary of it as our time here will admit. He commences his article with the statement that Leslie was the first to observe that a body with a rough surface radiates more heat than a body with a smooth one, and he thought this was conditional on the density of the surface, yet he urged against this view the circumstance that the limit between hard and soft bodies cannot be fixed. Melloni subsequently maintained that the altered radiation depended merely on a change in the density of the superficial layer. In support of this view Melloni adduces the fact that in certain substances, such as glass, marble, agate, he found no change in the radiation, whether the surface were rough or polished, and only in the case of metals was there an increase when they were roughened. He ascribes this difference tc metals being compressible, and that metal plates made by rolling or hammering have a greater density on the surface than in the interior. Looking at a list of radiating powers of bodies, it is at once seen that in general this property is inversely, as their respective densities, and as the different densities of one and the same substance. In support of this view he made the following experiment: He constructed a quadrangular box with a metal bottom, using for its sides four plates of silver, two strongly hammered, and two cast, and allowed to cool very slowly in their molds of sand, and in order not to alter the density of the plates they were polished with pumice stone and charcoal, without the use of the hammer or burnisher. Then they were joined together and to the bottom by means of soft solder. The outside of one of the cast and one of the hammered plates was then strongly rubbed in one direction with coarse emery paper. The sides which retained their lustre reflected sharp images, the rubbed sides dull and streaked ones. The silver vessel thus prepared was filled with hot water, and the radiation of heat therefrom reaching the thermo-electric pile, the deflections of the needle were for the hammered and polished side, ten degrees; the hammered and scratched side, eighteen degrees; the cast and polished side, 13.7 degrees; the cast and scratched side, 11.3 degrees. Scratching the hammered plate had thus produced an increase of radiation, while in the cast plate it had produced a diminution. This unexpected fact appeared to Melloni to prove the correctness of his principle. We are as much and perhaps more justified in saying that the surface becomes denser by scratching than in saying with Melloni that it becomes less dense; for during the scratching a pressure is exerted upon the surface, and if even it be asserted that the individual scratches are not pressed in, but are scooped out in this scooping, a pressure is exerted upon the adjacent parts, which, even though exerted laterally, must necessitate a condensation. Prof. Magnus alludes to other experiments made by Melloni and Knoblauch which seem to confirm Melloni's views, and then gives experiments made by the author with platinum plates, instead of copper, and other easily oxydizable metals, so that other alterations also on the surface, such as are produced on silver by small quantities of sulphuretted hydrogen, were not to be feared. A platinum plate made as hard as possible before rolling after having been heated, radiated as much heat as before. Here hardness cannot have affected radiation. Another platinum plate had been passed under very great pressure between two rollers, one of which was finely grooved; so that after this treatment one of the sides exhibited small elevations, while the other remained smooth. The first radiated slightly more than the other, but after the plate had been strongly heated even this difference was no longer perceptible. Hence it follows that when surface is otherwise the same, inequalities, and even regularly alternating elevations and depressions, may exist without any increase in the radiation. When, on the contrary, a plain platinum plate, which had been heated by a glass-blower's lamp, and was quite soft, was roughened by means of fine emery paper, the radiation was doubled. When a platinum plate was covered with a thin layer of spongy platinum, by spreading a thin layer of ammoni chloride of platinum upon it, and then strongly heating, without treatment with nitric acid, it indicated seven times as much radiation as before being treated with spongy platinum. The author concludes that the increase of radiation with a roughened surface depends essentially on the refraction which heat experiences on its emergence from the surface of a radiating body. The greater the refractive index of heat between the radiating substance and the air, the smaller is the radiation from the plane surface, and then the quantity of heat reflected inward increases. The metals have doubtless a very high refracting index. Hence they reflect the rays from without and allow but few to penetrate, and hence they reflect internally those coming from the interior, and allow but few to emerge. Great inequalities of radiating surface do not occasion any important alteration in the radiation. Such a one only occurs when the radii of curvature are very small and change greatly, and when the radiating surface has but little diathermancy. In general, the roughness of the surface may effect both an increase and a diminution in the radiations; but if the inequalities are very fine and very deep, there is almost always an increase in substances like metals. When there is a very fine powder of the same substance on almost any radiating surface, the radiation is considerably increased.

The President.—This I regard as a very important paper. These experiments tend to overthrow our ordinary idea of an increase of surface increasing radiation.

Dr. D. D. Parmelee.—This account is very interesting, but it lacks detail. How were these experiments conducted? Were these metals first heated to a temperature, and then tested with the thermo-electric pile? Or were the experiments tried with a small stove? or how were they tried? The whole gist of the thing lies right there. If you take a brick of glass and a brick of clay, and place them in an equal exposure, the glass will retain the heat the longest. Cast iron will become cool sooner than either. The details are important; and especially we ought to know how the heat was applied.

Dr. L. Bradley.—A rough surface will cool down quicker than a smooth surface, for the reason that there is a greater surface exposed to the air. But radiation is the natural emission of heat from the substance. It is evident that a substance will cool more rapidly from conduction, or by convection rather, if the surface is large than if the surface is small, being surrounded by water or air. True radiation, independent of conduction or convection, I suppose is equal, whatever the surface.

Dr. D. D. Parmelee.—Color has an important effect upon radiation. Black will assist in the radiation of heat. In the frigid zone all the animals are white, so that they may better retain the heat of their bodies. In the temperate zone animals are gray. In the torrid zone the color is black; as the African is black.

Prof. J. A. Whitney.—It seems to me that it may all be explained upon the principles stated by Dr. Bradley. It appears that when powdered particles of the same substance are spread upon a radiating surface, "the radiation is considerably increased;" but this is evidently because there are more particles to convey the heat away through the air.

Dr. John B. Rich.—Under certain conditions an oxyd of a metal upon its surface acts as a non-conductor. If a powder of the same metal is thickly spread over the surface, its numerous air-cells would retard the radiation of heat. So a sponge platinum, or a platinum plate containing an immense number of air-cells, will radiate less than an ordinary platinum surface. There are several points in regard to which, from the reading of the papers, I could not understand the exact conditions under which the experiments had been tried. Objects will radiate more or less, for instance, according to the color; but color cannot operate where there is no light. The conditions of the experiments are not stated sufficiently to enable us to judge of the results. How is the heat applied? If by a flame, we must remember that a flame varies constantly in its heating power, and that at the same moment the heating power of different parts of the same flame is widely different.

Prof. J. A. Whitney.—With regard to definiteness, I think the details are sufficiently explained for all practical purposes. The essential point is the result, and the standing of the experimenter is the guarantee of their accuracy. In one of the experiments he appears to have used a cube filled with hot water; and that would certainly give a sufficiently accurate indication. A box can be filled with water, or steam, or air, of any desired temperature. Any man can find means to repeat the experiments, and the fact that he would be thrown upon his own resources with regard to the minor details, would be an advantage; for, if the results agreed, the very fact that the details differed in some respects, would be an additional confirmation of the principal sought to be established.

Dr. John B. Rich.—It is true that we may make new experiments, but in order to verify the experiments already made by repeating them, we must know all the conditions. For instance, we must know whether the water was kept at the boiling point, or merely poured in.

Dr. D. D. Parmelee mentioned, as an analogous case, the instance of a chemist who reported that, after exposing lead pipe to the action of water, he found seventy-five grains of lead in the water, and after exposing a certain alloyed pipe, he found fifty grains in the water, but did not state the amount of pipe that was exposed to the water. Some substances are transparent to light and not to heat, and *vice versa.* Make a lens of bisulphide of carbon and iodine, and it is perfectly opaque, but you can light a cigar with it; or we may make a lens perfectly transparent, which will absorb all the heat.

The President stated that any one desiring to repeat the experiments, could find all the details in the article in the new Edinburgh *Philosophical Magazine*, from which this abstract had been made.

Dr. Bradley.—If I recollect rightly, it was stated that the box used in these experiments contained hot water. Now, I do not suppose that a man like Melloni would prosecute such experiments without having a thermometer in the water, for the purpose of keeping up a uniform temperature. Radiation I regard as a universal force. Every substance, in a cooler medium than itself, constantly radiates heat exactly in proportion to its free heat; by which I mean the heat which is not latent. That is the universal law of radiation. But conduction and convection would depend to a great extent upon the kind of surface exposed.

THE PHENOPHTHALMOTROPE.

This name has been given to a machine invented by Dr. Donders, of Utrecht, for elucidating the movements of the eye-ball. By means of it the mathematical analysis made by Professor Helmholtz of the occular movements may be practically demonstrated.

WOOTZ OR INDIAN STEEL.

Dr. Rammelsberg gives, in a Berlin journal, the result of his analysis of a steel bar, certified to be true Indian steel by the late East India Company, and deposited in the museum of the High Polytechnic School of Berlin. Aside from the iron, it contained the following substances given in thousandths of one per cent: Carbon, 0.887; silicium, 0.136; phosphorous, 0.009; sulphur, 1.002. It is significant that the author found no aluminum, in this specimen, since the late Messrs. Faraday and Stodart, who made the first analysis of Wootz as early as 1819, stated that the peculiar qualities of this steel were due to silicium and aluminum. The specific gravity of the specimen used by Dr. Rammelsberg was found to be 7.822.

MIRAGE IN THE BRITISH CHANNEL.

Mr. Thomas Waring gives, in the Meteorological Magazine, the following description of a mirage of unusual splendor:

The party on board of my yacht, Hadassah, on her passage from Alderney to Guernsey, witnessed a phenomenon so striking, and in these latitudes so rare, that I am tempted to send you a short account of it. The wind was light, from E.N.E., the sky cloudless, the sun very hot, and the barometer steady at 30.21. There had been some signs of fog in the morning, but they had disappeared. At about 3.30 in the afternoon we observed over the small island of Herme a peculiar hazy reflection, which became more and more defined, until it presented an exact inverted image of the land beneath. A similar effect was soon visible round the whole horizon. The islands Alderney, Guernsey, Jersey, Sark and Herme seemed raised to more than twice their height; sharp-pointed, outlying rocks were capped with inverted images of themselves, apparently balanced upon them, point to point, like enormous rocking stones. The Ortach rocks, of which we had previously lost sight, were now to be seen with startling clearness in the air. The Casquetes with its three light-houses, presented a most curious appearance. The light-houses were drawn out into colossal pillars, on whose summit rested a huge mass of rock, clearer in the outline than the real island beneath. Ships were seen sailing keel upward through the air, every sail and spar distinct, and in some cases the images were re-duplicated. Several of the vessels thus reflected were below the horison, and invisible to us. The northern end of Guernsey, where the land runs low, was twice reflected in the air, so distinctly that even those who were familiar with the island found it hard to recognize it. We seemed to be looking at some half-merged country, where countless still lagoons were divided from each other by narrow strips of land. As we neared Guernsey, the picture became less distinct, but meanwhile the mirage was becoming more wonderful still all over Alderney. Here the deep-marked cliffs were magnified to an apparent height of many hundred feet, and no scene-painter, devising a grand transformation scene, ever dreamed of more fascinating groups of basaltic columns, grottoes and rock arches, with the tide flowing beneath, than was exhibited by the island and the isolated stacks around it. Having remained visible for more than three hours, the panorama of wonders gradually faded away, and by seven o'clock the horizon was clear, save where a dark narrow line or cloud of mist hung low in the north-east. I may add, for the information of weather prophets, that this unusual state of the atmosphere was not the forerunner of high wind, or of any change in the weather."

Dr. Rich described a beautiful mirage he had witnessed in the desert, among the Arabs. They had lost the spot where they expected to find water, and they found it by the aid of the mirage, which was very clear and distinct. Objects were slightly enlarged. There was so small a quantity of water that it could not have been diffused in vapor to form a reflecting surface. The weather remained unchanged for two or three days afterward.

Prof. Whitney stated that there were two kinds of mirage, one in which the objects are seen by reflection in the air, and another in which by refraction they are raised above their true position. He described a beautiful mirage which he had witnessed in the great desert of the west, in which the clouds assumed the form of castles, cities, and a beautiful landscape, and every object appeared vivid and distinct.

THE SCARLET FEVER.

From accounts of the havoc made by scarlet fever in almost every part of this country, we have long regarded it as the greatest scourge of our race. Unlike most contagious diseases, it often leaves those who are said to have recovered from it with other complaints more painful than the first. Our impressions are confirmed by the following statements, from the *British Medical Journal*, which will strike all thoughtful persons as appalling:

"During the twenty-one years, from 1848 to 1868 inclusive, there were registered in England and Wales, 415,982 deaths from scarlet fever, and its allied disease, diphtheria. To bring this number down to the present time, exact data are not yet forthcoming, but it may be estimated, that at least 40,000 deaths have occurred throughout England last year. In the six months, ending June last, 13,900 deaths were returned, as resulting from scarlet fever and diphtheria, a number which we suspect, however, to be under rather than over the mark. Here, then, we have an aggregate in round numbers, of 470,000 persons, who have fallen victims to one type of zymotic disease, in the last twenty-two and a half years. But what of those whom the disease attacked, but did not kill outright? On the most moderate assumption, it is probable that at least 5,000,000 of persons in England, have, during the last twenty-one and a half years, suffered more or less severely from attacks of scarlet fever and diphtheria. That a considerable number of these persons, ultimately perished by other maladies, either induced by the original attack or supervening on a broken constitution, must, undoubtedly, be taken for granted."

Ought not the votaries of science to make a systematic and united effort to provide trustworthy means, both for the prevention and cure of scarlet fever? We have heard of remarkable cures, by means of sulphite of soda, carbolic acid, and other antiseptic preparations; but there is no settled practice among the best physicians, in combating this disease, and there will be none, until the cause of it, and its cure, have been made the subject of a most searching and exhaustive series of scientific investigations.

Dr. H. D. Sheppard stated, that for several years, he had carried his patients through the scarlet fever, without losing a patient, and without leaving any relics, such as sore eyes, ears, throat, etc., employing no drugs, inside or out, but merely by the use of water, upon the principle of cooling the fever and cleansing the skin, and determining to the surface by fomenting bandages. He had applied the same principle, with equal success, to the treatment of hooping cough, small-pox, chicken-pox and measles. Children attacked with these diseases, need to be kept from exposure for some time after they want to be out of doors at play.

Dr. J. W. Richards.—Scarlet fever is a disease of different degrees of severity. At one time, the epidemic may prevail, and there will be no deaths ; at another time, ten may die at once. There was a period of twenty years, when scarlet fever disappeared from the world. When it reappeared, it came with great intensity. I believe there are cycles, periods of five, ten, or twenty years, when certain forms of disease prevail, which are succeeded by other forms of disease. About twenty years ago, the time of the reappearance of scarlet fever, the clergyman's sore throat was first known. There was a time within our recollection, when dyspepsia was unknown, and people had to go to their dictionaries to learn what it meant. Pretty soon it was in everybody's mouth. So with neuralgia. A few years ago, nobody knew what it meant. Very soon, everybody was sick with it.

Dr. Weeks stated, that nineteen years ago, there were a great many cases of scarlet fever, in Carbondale, of which about one-third were fatal. He had treated twelve cases without drugs, by water, three of which were his own children. One of his own, and one other child died. One of his own, even after being taken with bloating, recovered ; all other cases taken with bloating were fatal. The subsequent effects were not as lasting as with the allopathic treatment.

A SECOND CROP OF STRAWBERRIES.

Dr. D. D. Parmelee exhibited ripe strawberries from a second crop now growing in Rye, taken from the vines on October 19th. The vines are full of strawberries and blossoms.

Dr. Richards stated, that it was not uncommon, in remarkably dry seasons, for plants to reproduce fruit or foliage intended for the succeeding year. The horse-chestnut tree will sometimes reproduce blossoms in October. It would be curious to see how large a ring of albumen would be formed by such a short season of three or four weeks only. Carrots, parsnips and beets, will sometimes, in a dry season, spring up, after an autumnal rain, and go to seed.

Professor J. A. Whitney, had seen the cockle blossom, even later than this, and other plants flowering late where they have been retarded in their growth.

Dr. Richards stated, that autumnal fruits come to maturity, very much more quickly than ordinary fruits, being hastened by the shortness of the season, as all vegetation is in arctic regions.

Adjourned.

October 27, 1870.

Prof. S. D. Tillman in the chair; Robert Weir, Esq., Secretary.

Prof. Tillman read the following scientific notes:

The Hot Blast for Blow-pipe Purposes.

Mr. W. Skey has given, in the London Chemical News, the results of his experiments in testing the effects of substituting a hot blast for a cold one, as heretofore used, for the production of the well known blow-pipe flame, which seems to show that a flame so produced has its thermal and illuminating power very greatly augmented. In his experiments, the temperature of the blast was, approximately, 500° F.; the diameter of the jet was one-thirtieth of an inch, and the combustible for receiving the blast was stearin. This flame manifested a very decided superiority over the common blow-pipe flame; substances difficult to fuse in the latter—magnetite, potash-feldspar, mica—readily yielded under these circumstances; while thick glass tubes, half an inch in diameter, and hard German glass tubes, were tractable to an eminent degree. Substances for the fusion of which the hydro-oxygen flame or some equivalent of it in heating power, is said to be indispensable, also yielded before the blow-pipe flame thus urged; for instance, platinum, pipe-clay, fire-clay, agate, opal, flint. Alumina only appeared to vitrify, while crystallized quartz could not be fused to a globule; their splinters, however, curled round upon themselves like scolozite, showing that the melting point was almost reached. It appears from this that a very small amount of some foreign substances exercise a marked effect upon the fusibility of silica, agate, opal, etc., being only a little less pure than rock crystal, though so readily fusible in this flame. The minimum temperature of the flame is estimated at 4,596° F., and as the actual temperature of Hare's hydro-oxygen and lime light is estimated to be only 2,000° F., the author suggests that air thus heated might be substituted for oxygen gas. As this heating of the air would involve the use of a furnace, the improvement could not be conveniently applied to the portable lime-light apparatus now in extensive use.

Dr. L. Bradley.—It seems perfectly reasonable to suppose that whatever heat is previously communicated to the air by which the flame is produced would be saved; for there must be a certain heat before the oxygen can unite, and if that heat is supplied in advance, the flame will be more intense.

The Chairman.—The only objection to it is, that it requires a furnace to heat the air; and of course for many purposes it would be inconvenient to prepare the apparatus to heat the air. In using the blow-pipe on a large scale, it will no doubt be found very economical.

Horse-Shoeing—The New Method.

At a late meeting of the Highland Society at Dumfries, Scotland, Mons. Charlier, by special invitation, explained the new method of horse-shoeing, invented by his father, a veterinary surgeon at Paris, which has been used with great success in France for five years, on horses employed in different services, and has received the sanction of the Imperial Agricultural Society. He said, substantially, a good system of shoeing has long been sought for; many would even no longer shoe the horse, to avoid the numberless defects of the usual mode. But the shoe is to this day the only way of preventing the wear of the foot; we must, therefore, try to reduce the size of the shoe as much as possible in reforming it. Our shoeing answers this universal want, being more natural or rather less artificial than any other, being more simple and rational. Seen in its ensemble, it is quite different from all other shoes known hitherto, on account of: 1st. The whole strength is left to the bare foot; also its whole form and whole function, by never paring the foot, never touching the frog, nor the sole, nor the bars. 2d. The new method of preparing the foot with new instruments to receive the shoe. 3d. The new fittings of the shoe round the hoof, this alone allowing the pressure of the frog on the ground. 4th. No beveling. 5th. Its elasticity. 6th. Its narrowness, resting only on the width of the crust. 7th. Its lightness, being about one-third the weight of the ordinary shoe. 8th. The new manner of forging the shoe—stamping and nailing it. A square or nearly square little bar of iron is turned cold, in a very short time, or hot; one man alone can stamp it with two rounded punches. The shape and direction of the nail holes are particular, necessitated by the unusual thickness and narrowness of the shoe. The exterior of the hole is a rounded oval; the hole is funnel shaped; the upper orifice is square. The nail has exactly the same shape—a head of lengthened cone shape, a neck strong and solid, and a square blade. The nail thus stops up the hole hermetically. With these conditions, the new shoe, of good quality of iron, is very solid on the foot—an important advantage, especially for hunters. Six, seven or eight holes have different directions, according to the inclination of the hoof; they are nearly straight toward the toe. A shoe with well stamped holes can be nailed without danger of injuring living parts, the holes being a guide to the nail. 9th. No calkins, nor hooks, nor toe-pieces. There is no need of calkins; the frog is a natural calkin on the slippery ground, sustaining the tendons instead of straining them. In case of frost, only two movable nail calkins are fixed toward the heels of the shoe; the toe forms a kind of hook by its narrowness and the inner angle of the shoe. These nail calkins can be fixed on by any one, not being in the horn, and, owing to the thickness of the shoe, are solid. They are taken off as soon as they become useless, being even hurtful on hard and level ground. In fine, the new shoe is not difficult to use, and no more liable to accidents than the ordinary shoe. It takes less time to forge it, a single man making from eighty to 100 per day; no longer time to fit it to the foot. It can be fitted cold as well as warm, and is suitable to all shapes of feet. It lasts a sufficient length of time, and is no more expensive than the common shoe. It is an orthopedic and pathological shoe; sufficient, frequently alone, to cure corns, contracted feet, and other diseases; being susceptible of modification according to the worst feet; and when the instruction of farriers is extended it will be known and applied easily everywhere.

Recording Steam Gauge for Boilers.

The Chairman.—It will be remembered that Mr. Edson exhibited apparatus here a year ago for recording the pressure in a steam boiler, and that there was much discussion about it at that time. Mr. Edson had made some improvements in his apparatus, and will now exhibit the improved recording steam gauge.

Mr. J. B. Edson produced one of the instruments and said: "This instrument is the invention of Messrs. B. & J. B. Edson, of New York city, and supplies a want now, more than ever before, felt. Inasmuch as it secures in the most efficient manner results of vast and world-wide importance, it deserves and will doubtless meet with an enviable notoriety. 1st. For what it accomplished for humanity by reducing the risk to life resulting from the dangerous and careless use of steam. 2d. For furnishing data valuable to the interests of science, and 3d. For securing the strictest economy in use of fuel and employment of time of all engaged in the generation and use of steam. It is termed a "steamometer," as it indicates continuously by pointer and dial plate the pressure of steam within the generator, automatically rings an alarm gong whenever such pressure is excessive, and at the same time it traces by vertical and oblique, or (when the chart is moved by power derived from the shaft of an engine) by continuous lines, every degree of such pressure upon a strip of paper called a "chart," whereby a person is enabled intelligently and thoroughly to inspect and criticise not only the work of the engineer and his subordinates, but also to make estimates from the results obtained, as of work performed by any given amount of steam generated, and with different kinds or qualities of fuel used, and to compare such data from day to day, or retrospectively, at any future time when either private, public or scientific interests may demand it.

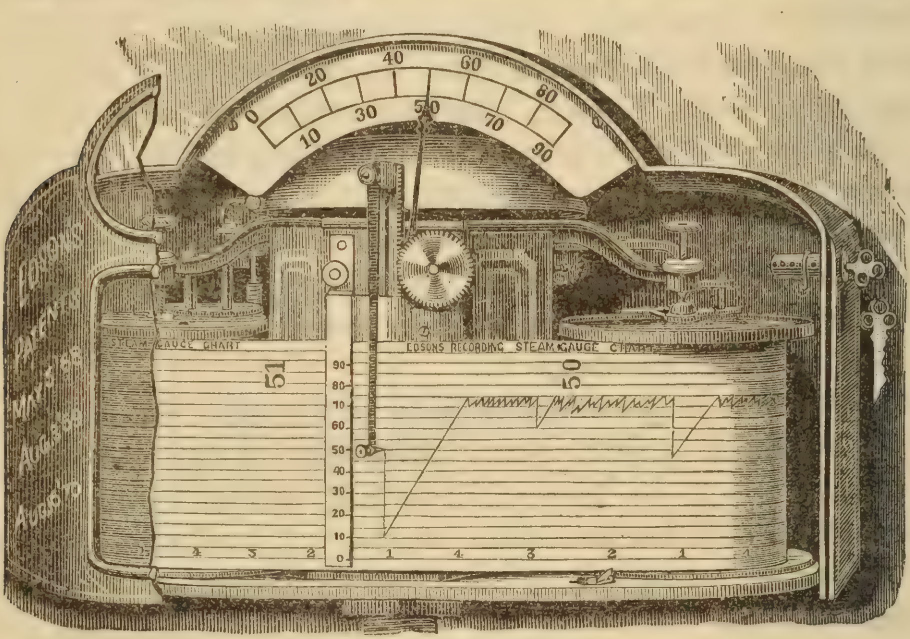
The steam pressure, and every fluctuation in the same, being thus not only "indicated" but accurately *recorded*, under the protection of a private lock and key, leaves no room for doubts or differences of opinion in reference to the facts in every case, and the want of such reliable data has heretofore been one of the most prolific sources of dissatisfaction, on account of the utter inability of individuals or juries to fix responsibility and blame, with unerring certainty upon the culpable party.

The word "recorded" is italicized, and it is important that the proper distinction be preserved between that word and the term "register," as it is too often used, the latter being very generally accepted as denoting a numerator or counter and not a recorder. In reality, the words "record" and "register" are very nearly synonymous, and the point urged is that to "count" and to "number" the strokes of a piston, or the revolutions of a shaft or of the driving wheel of engine, is one thing, and either word is generally correct when so used; nevertheless, to "record" or to "register" those same phenomena is entirely another thing, and should always be definitely expressed, so as to admit of no possible equivocation or misapprehension in regard to the intended meaning. It is a maxim in the English law that "nothing can be averred that is out of record," *i. e.*, unregistered. There can be no doubt but that these logs or steam written "charts," obtainable from these instruments (and from these alone, they being continuous for days or weeks as is desired), will for all future time be considered indispensably necessary. The reasons therefor are, it would seem, too obvious to require enumeration, especially to any reflecting mind.

An engineer owes it to himself, and to those dependent upon him, that he protect not only his life but his reputation, to the utmost, against accident or evil design. And these charts will and can be made to refute and disprove unjust aspersions against his character and habits as easily as to make manifest, beyond question, his ability and fitness for his position when the one or the other is called in question, and these results (verifications) cannot be otherwise obtained.

Hence, it follows that, without such data, as is now by these means obtainable (strange to say, for the first time in the hundred years in which steam has been used), it has been impossible to learn the facts touching the use (or the abuse rather) of a boiler retrospectively, in the same manner as the flaws or defects in the title to a piece of real estate have always been ascertained, and always will be, viz.: by searching the "records" or "registers." It is foolhardy and barbarous to hold human life less dear and less worthy of protection than the possession of a piece of land, and it is worthy of special note that although no sane man ever bought a piece of real property, however insignificant its value, without searching for defects, and being indemnified against incumbrances. Nevertheless, with all the ordinary precautions taken heretofore to ascertain the real condition of steam generators, before purchase or use, and at the usual intervals of a year, perhaps during use, it is generally admitted that the "inspectors' certificates" are little better than a sham and a snare! With the aid of these unimpeachable records, however, an inspector of boilers can, at any time assure himself, with the utmost certainty, not only respecting their value for present or future use, before certifying to the same, but he can thus be enabled also to judge correctly of the conduct of the engineer in charge, as well in reference to his capacity and fitness for responsibility as to his fidelity in the discharge of his own proper duties, in addition to the exercise of necessary supervision of those under his charge.

Employers who have heretofore been of necessity precluded from intelligently supervising the performance either of their machinery or their employes, are, by these self-recording gauges, enabled to see retrospectively what has been done, or what has been left undone, and who has, either by neglect of his duties or by reckless or unskilled conduct, incurred censure, or has by faithful and intelligent action entitled himself to promotion, or at least the most honorable mention. Underwriters as well as the public everywhere will, and it is believed do already, so far as their knowledge of this invention extends, manifest extreme interest in this improvement in steam apparatus. The risk to both life and property heretofore incurred from the use of steam power, at present so universally extended and varied, will be greatly diminished where these guages are used, and the boilers in every passenger-carrying steamer, also of every manufactory and locomotive, will doubtless soon be provided with them; and, if steam users will not voluntarily supply themselves with these instruments as fast as they can be obtained, they must not complain if municipal or other authority compel their use, and thereby protect those whom they thus criminally endanger. The courts now hold that steamboat owners, railway companies, and in fact all users of steam power, are criminally liable if they refuse or neglect to use every available appliance known to secure the utmost degree of safety to the property and lives of those who are directly or indirectly exposed to danger by such parsimony, which it seems even common prudence would always discountenance. The case of *Dyke* v. *Erie Railroad* is in point, in which the Court of Appeals has just affirmed the judgment of the court below, awarding $35,000 to the defendant for injuries sustained at Carr's Rock, April, 1868, which sad disaster a careful foresight might have avoided. Improvement progresses in proportion as ignorance is displaced by knowledge, and employes may be educated in their duties, as well as intuitively prompted to careful habits, by the use of these instruments.



EDSON'S RECORDING STEAM GUAGE.

If, as is claimed by these inventors, these instruments shall prove to be more reliable for accuracy in denoting the steam pressure than the guages heretofore used, in addition to their recording features, users of steam will not fail to discriminate in their favor. A watchman of this kind will supervise machinery and workmen with more fidelity than many a living watchman. The steam enters by an ordinary pipe-coupling into a series of circular, horizontal chambers, placed behind the pencil-bearing, and by expanding them is made to operate the gear, causing the pencil to move upward in proportion to the degree of steam pressure, and the alarm to ring continuously when the previously fixed limit is reached or extended. The reverse movement of the gear, produced during the reduction of pressure, moves the pencil downwards simultaneously with the rotary motion (given by means of a horizontal rack and lever operating a pawl within the upper rim) of the receiving drum, and, in consequence of the motion thus given to the chart, the pencil is made to trace an oblique line, invariably in proportion to the fluctuation or reduction of pressure. The chambers consist of pairs of corrugated steel discs, each disc, as well as the other motive parts, being nickel plated to prevent them from corrosion, even in a saline atmosphere. The vertical scale is placed at the left of the pencil as a guide for the chart, also for greater convenience when marking the pressure upon the chart previous to its removal for preservation. The "charts" are divided into sections, numbered consecutively, as at "50," "51," etc., the sections being subdivided into four parts, as "1," "2," "3," "4," for the purpose of precision in defining the work performed by each engineer during his "watch," or by the engine itself when for any purpose it is desired. One of these charts will last an ocean steamer for years without renewing.

There are three different forms of these instruments. They are thus adapted to locomotives, stationary and marine boilers of high or low pressure, and will probably soon be so arranged as to afford a chart of the "H. P." when required for practical or scientific purposes. They are exhibited by the Recording Steam Guage Company of New York."

Dr. L. Bradley.—The method of indicating pressure here employed is the same with that of the aneroid barometer. There will certainly be a great saving of coal from the constant recording of the pressure, and by and by, when it is found that no explosions occur where this guage is in use, it will be adopted as a safeguard also.

Mr. J. B. Edson.—By keeping this record we are enabled to distinguish between those firemen who neglect their work and those who feed their fires regularly. When in the naval service I made extracts from the logs, and contrasted the amount of fuel required by different engineers to do a given amount of work, and I was surprised by the results. I could trace a "watch" right through, and find a saving of ten or fifteen per cent in the consumption of coal. When they were burning forty or fifty tons of coal per day this would amount to a great deal. In some of our factories large amounts of coal are burned, and the proprietors hardly consider what a saving might be made. If the coal does not last they blame the coal, when it may be the fault of the fireman. If a record is kept, and the firemen know it, they will be induced to be more watchful of their fires, or if they are not, the engineer will know which are the men to be replaced.

Mr. M. B. Edson.—I have been at work upon this invention for four or five years; and a year ago last December we presented the instrument here in the form it had then. It will show an appreciation of its usefulness for me to state, that during the last few months I have obtained the approvals and signatures of nearly all the fire, life and marine insurance companies doing business in the city of New York, representing at least $350,000,000 of capital, and also of prominent steamship owners, mechanical and civil engineers, merchants and others. When we consider how many lives are constantly imperiled by the neglect of firemen and engineers, is it too much to ask that Congress should make it obligatory to use upon all steam vessels mechanical means for constantly recording the pressure in the steam boiler? It is certainly remarkable that a hundred years should have elapsed since the invention of the steam engine before a gauge was invented which would automatically record upon charts the degree of pressure in the boiler. Such a record will render steam a better servant than it now is, and will prevent its obtaining a mastery over us.

SMITH'S CLOTHES-WRINGER.

Mr. C. S. Harvell exhibited the clothes-wringer invented by Gilbert Smith. It consists of a framework to be placed over the tub, having a network rope tube to be filled with the clothes, and a handle to be turned, which twists the tube from one end, shortening it and reducing its diameter, so as powerfully to squeeze out the water without injury to the fabric.

Mr. J. B. Edson stated that, from an examination of this wringer, he was satisfied that it was durable and a valuable substitute for the much more expensive rubber wringers in common use. The rubber wringers have thus far had no serious competition in the market.

The President.—Will this wring clothes as fast as the other?

Mr. J. B. Edson.—No, sir; I think not.

Mr. C. S. Harvell.—We claim that a washing of clothes can be wrung out with this wringer in one-half the time it would take a roller machine to do the same work. We can throw in a large sheet or half a dozen pillow-cases or shirts, hap-hazard, give a few turns, and the work is done; while it would take twelve or fourteen turns to pass a sheet through rollers.

Mr. Edson.—This wringer has the advantage that it is not so hard on buttons as the rubber wringer; but I should hardly think it would operate as rapidly, because its action is intermittent and the other is continuous.

LABOR-SAVING HOOP MACHINE.

Mr. A. McAlpine exhibited a model of an improved machine for shaving barrel hoops. It makes 2,000 revolutions per minute, and the hoop is moved three-eighths of inch to each revolution, so that it will shave either straight or crooked hoops at the rate of sixty feet, running measure, per minute. The machine could be seen in operation at the American Institute fair.

ON THE DETERIORATION OF COAL BY ATMOSPHERIC INFLUENCES.

Dr. Adolph Ott read the following paper:

In the year 1863, Herr Grundmann, of Tarnowitz, in Germany, published experiments on the deterioration of soft coal. According to these experiments, it appeared that a long exposure to the air did not alter the specific weight of coal nor the amount of water contained in it. Yet it seemed that the per centage of ashes was thereby considerably increased. At the beginning of the experiments it was found that a certain kind of coal yielded 4.5 per cent; after two months' exposure, 6.2; after five months, 10.4; and after nine months, 10.8. As it is likely that the absolute quantity of mineral ingredients in a coal remains the same, no matter how long it is exposed, Grundmann concluded that the coal underwent a process of slow combustion, taking up oxygen and giving off the volatile products of oxydation. Coal which, after nine months' exposure, yielded 10.8 per cent of ashes, would thus have lost 58.21 per cent in weight, namely, from 1,000 pounds of coal, only 418 pounds would remain after the stated time. It is evident that these statements caused the greatest attention among coal producers as well as consumers. They called forth considerable discussion in the Society; some distrusted the reliability of the experiments, others were enthusiastic in their praises of the triumphs of science. In 1866, however, the administration of the State Railway of Hanover, justly appreciating the importance of the subject, instituted controlling trials, which were mostly made by Director Reder, then in Osnabrück, now in Berlin. These experiments led to the following results: In three cases in which the coals had not grown hot, the weight had remained the same; in three others in which they had become warm, they increased in weight instead of having decreased. Rider, who was then not aware of the fact that coal absorbs oxygen at ordinary temperatures, supposed that he had to ascribe the just mentioned results to an error in the method of observation.

Up to the present year no further experiments were made in this direction. A few months ago, however, Dr. E. Richter, of the Mining School in Waldenburg, Germany, has again taken up the subject, and gives, in a late number of the *Polytechnic Journal* of Dingler, the results of his investigations. Richter justly declares the process of deterioration as one of chemical and physical change, by which the value of the fuel as a heating and illuminating material is more or less depreciated. He considers the conclusions of Grundmann as based on an erroneous method of investigation. "Nothing is easier," says he, "than to determine the amount of ashes in a given sample of coal, but it is very difficult to select samples from one hundred or one thousand tons of coal which will represent the average amount of the entire map. The errors arising from this inaccuracy must evidently be the greater the smaller amount of ashes." The following is condensed from his report:

I. The deterioration of coal is the result of a combined action of heat and the absorption of oxygen, which on the one hand combines with a part of the carbon and hydrogen to form carbonic acid and water, and on the other enters directly into the composition of the fuel.

II. The process of deterioration commences with an absorption of oxygen, which generally decreases in time. At ordinary temperatures, and with most coals, absorption and oxydation are going on so slow that, even within one year, no change can be detected in the composition of the coal.

III. As long as the temperature does not exceed 340 degrees F., no perceptible loss of weight takes place; on the contrary, it has been ascertained that coals often increase in weight, which is the result of an absorption of oxygen.

Grundmann himself asserts that the volume of a heap of coal which has grown warm does not decrease, and that the specific weight remains nearly the same. If it were true that such a heap would loose half of its substance, the specific gravity of the remaining coal would just be one-half of the original one; or, a railroad car which holds ten tons of fresh coal, would only hold five of the decomposed one. This, however, is contradictory to all experiences. It has been adduced that the earthy appearance which some coals present after long exposure to air and moisture, is the result of a loss in weight; but this is not the fact. Every lump, as well as a whole heap, may be compared to a porous body impregnated with a solution of salt. This salt goes to the surface in the same proportion as the water evaporates, until it covers the entire surface. According to the observations of Richter, the earthy covering consisted, in a coal of Waldenburg, of sulphate of lime, which had been formed by the action of moisture and air on the pyrites and the carbonate of lime, which latter substance seems to be a constant ingredient.

The decrease in heating and illuminating power, as well as in the liability to cake, to which coals are subject by deterioration, is explained by the absolute and relative decrease in carbon and hydrogen, and by the absolute increase of oxygen. As to the heating power, Richter asserts that at ordinary temperatures the same will, in a year, only amount to a few per cent; that if the temperature in the heaps remains at 170° or 180° F. for a few weeks, it will reach this amount after that time, and if the temperature exceeds 212° F., the stated loss will be perceptible in a few days.

The coking quality of coal, according to Fleck, depends upon the amount of hydrogen it contains, and it may be shown that the capability to coke becomes less if hydrogen is given off and oxygen absorbed. This takes place in heating, as well as in the process of deterioration.

According to Richter, the generation of heat is the *conditio sine qua non* of decomposition of coal. He refers in his paper to a certain class of coals—to those liable to self-combustion—that are mostly subject to deterioration, but without describing them farther. I infer from his paper that its deterioration depends rather upon the physical condition of a coal than on its chemical composition, and shall endeavor to settle these points by experiments. I do not regard the investigations referred to as altogether satisfactory, but considered them of sufficient importance to attract attention. In conclusion, I would invite the chemists of this society to institute experiments on what seems to me a very important subject.

Dr. Bradley.—Is there a similar effect upon charcoal?

Dr. Ott.—These experiments only refer to mineral coal.

The Chairman.—I suppose, too, that they only refer to soft coal. I hardly see how they can apply to our anthracite coal. We had a discussion upon this subject two years ago. Dr. Ott proposes to institute still further experiments, and asks the co-operation of other members of the Institute.

Dr. Bradley.—Is the spontaneous combustion which sometimes takes place in large quantities of coal, probably caused by such a process as is described in this paper?

Dr. Ott.—Certain coals are more liable to spontaneous combustion than others. The cause is not explained. I suppose it depends rather upon the hydrogen they contain than upon the sulphur.

Mr. J. B. Edson.—Tropical heat, as well as the rapid rains of tropical climates, seem to have a serious effect upon anthracite coal. I recollect that coal which was shipped in the West Indies, after an exposure of five years to the weather, we found it almost impossible to burn. This was government coal, placed in the care of our consul at Cape Haytien, for the benefit of our cruising vessels. It was totally inefficient and useless from the mere effect of a constant exposure to the sun and rains. I have observed that in South America and in tropical climates generally, they are more particular about protecting their coal than we are. It is stored in substantial buildings, whereas we hardly think of putting a shed over in. Hard coal seems to be as liable to spontaneous combustion as soft coal. I have known anthracite coal to take fire in iron vessels and to burn for weeks before it could be put out. Whether it took place from the motion of the vessel or from spontaneous combustion, I do not know.

The Chairman.—Hard coal will not take fire except at a high temperature, probably 1,000 degrees Fahr., or about that; and no mere pressure would cause that amount of heat.

Mr. Edson.—Might it not possibly take place from the motion of the vessel shifting a large body of coal?

The Chairman.—I suppose a great deal of hard coal contains a small percentage of hydrogen and of sulphur, which would be more easily inflamed.

Dr. Ott.—It seems to me nearly settled that it is not moisture so much as heat that causes spontaneous combustion; and hard coal seems to deport itself like charcoal, having the property of storing up large quantities of oxygen, mingled, perhaps, with some nitrogen.

Mr. Edson.—The hard coal I referred to had this peculiarity, that it was very hard; twice as hard as any other. It also had a sulphurous appearance.

The Chairman.—Charcoal has the power of absorbing many times its own volume of certain gases. I do not see how hard coal could absorb much; but it might, when broken up into fine particles. There is a good deal of mystery yet about the whole subject.

Mr. Partridge.—Two years ago, I had occasion to observe another peculiarity of coal exposed to the weather. It was chestnut coal, part of which was exposed to the snow, and the rest of which was dry. The gases from the coal which was exposed to the snow attacked the iron like powerful acids, and before the winter was out, the rods, which were from one-eighth to one-fourth of an inch in diameter, were entirely destroyed, so that some of them were not larger than needles. They were renewed and again almost entirely destroyed; and the sheet iron, Russia iron, was eaten through that winter the second time. We noticed that the eating was very rapid whenever we were using coal that had been wet. At the same time the amount of ash appeared to be greater, although we did not weigh it.

Dr. Bradley.—I apprehend that if we should subject a piece of the hardest coal to a very powerful microscope, we should find that it would develop infinite interstices, and appear to be a very spongy substance. Every molecule of matter is in motion. Nature knows no such thing as perfect rest, anywhere in any of her departments.

Adjourned.

November 10, 1870.

Prof. S. D. Tillman in the chair; Robert Weir, Esq., Secretary.

The Chairman read the following notes of scientific progress:

A Test for Paper.

A weak solution of sulphate of aniline is now used for detecting the presence of wood fiber in paper. One drop of the liquid on a pointed glass rod applied to paper containing such fibre, even in minute quantities, if prepared in a mechanical way, will produce an intense yellow color. This reaction does not take place when the wood fiber has been chemically prepared.

Spontaneous Combustion of Black Silk.

Dr. E. Dingler records, in the *Polytechnic Journal*, a case of fire occurring in a silk store of Paris, the origin of which was traced to a package of black-dyed silk which had been brought from the dye-house within the previous twenty-four hours. This is not the first instance of the spontaneous combustion of black-dyed silk, the cause of which Persoz and others have failed to fully explain. Dr. Dingler advises mercers to keep such silk in small parcels, and to prevent its getting too hot by proper ventilation.

THE VENOM OF SCORPIONS.

Dr. Jousset gives, in the *Comptes Rendus*, a detailed account of his experiments on the venom of the *Scorpio ocitanus*, frequently found in southern Europe. He concludes that this venom acts solely on the red globules of the blood, by depriving them of the property of gliding over each other; thus they become an adhesive mass, which obstructs the circulation of the blood in the capillary portion of the vascular system. In the particular of a definite quantity being required to produce chemical action, this venom differs widely from virus which acts as a ferment.

GINGILIE.

This oil is obtained from an African plant (*Sesamum Indicum*), which is now extensively raised in Ceylon. If this oil be the same as that called sesame oil, it differs widely in chemical composition from olive oil, to adulterate which it is sometimes employed. Gingilie is prepared from the seed, which yields from forty to forty-four per cent of a pale, straw-colored oil. Being devoid of smell, it may be used for extracting the perfume of flowers, such as the jasmine, tube-rose, camomile, and yellow rose. For this purpose, one weight of flowers is added to three weights of oil in a bottle, which is corked and exposed to direct sunlight for forty days, when the oil will become impregnated with the perfume.

EVAPORATION FROM FOLIAGE.

Von Pettenkofer has experimented with an oak tree during one season to ascertain the amount of evaporation from its foliage. The number of leaves on the tree was estimated at 751,592. The rate of evaporation was found to increase from May to July, and the total amount of the evaporation was found to be eight and a half times more than that of the rain-fall. The excess must be drawn up the roots from a great depth, and thus trees prevent the gradual drying of a climate by restoring to the air the moisture which would otherwise be carried off by drainage. This experiment clearly shows how climatic changes have been produced by planting trees.

AIR AND OCEAN CURRENTS.

Mr. J. Knox Laughton, in a recent contribution to theoretical meteorology, entitled "Physical Geography in its Relation to the Prevailing Winds and Currents," concludes that wind, acting not only on the surface of the sea, but, by means of intense friction, to a considerable depth, is the chief cause of the numerous ocean currents. His theory is, that the whole atmosphere, relatively to the surface of the earth, continually moves, or tends to move, from west to east; and that the prevalent local variations from that direction are either eddies or deflections, formed in accordance with the principles which regulate the motion of fluids. It is hardly necessary to add that Mr. Laughton's conclusions are not accepted as correct by many prominent scientific investigators.

DIRECT VISION SPECTROSCOPES.

The supposition is very prevalent that, for the purpose of viewing the phenomena exhibited by the spectroscope, a large and costly instrument is necessary, yet a small and cheap instrument may now be obtained which is capable of revealing all the peculiar and striking phenomena of spectrum analysis. A firm in New Jersey, instrument makers for the Stevens Iustitute, Hoboken, are now making pocket spectroscopes, equal if not superior to those of foreign manufacture. The instrument consists of a brass tube, upon one end of which is a carefully-made slit, the width of which may be increased or diminished by simply turning a milled ring upon the exterior; within this tube slides another, carrying an achromatic lens for "focusing" the slit; within this again slides another, carrying the compound prism, which comprises five distinct prisms, partly of crown and partly of flint glass, arranged so as to give direct vision. All its parts are carefully finished, and the instrument, in general appearance, resembling a diminutive spy-glass, is inclosed in a cylindrical case so as to be carried in the vest pocket without injury. With this little instrument, costing only fifteen dollars, most of the absorption bands of the solar spectrum, the phenomena of absorption by gases and fluids, and the bright bands of the alkalies and alkaline earths are easily discernable.

ROAD LOCOMOTIVES.

Mr. J. K. Fisher read the following paper:

I propose to compare three road locomotives: Thompson's, Aveling & Porter's, and my own. These machines may be seen at work, within a few miles of us; not all of them in perfect shape for ordinary haulage, but in such shape as will enable experts to judge which plan is best.

Two of Aveling's, imported last year, are used as road rollers, in Central and Prospect parks. Mr. C. C. Martin, C. E., under whose charge the one in Prospect Park worked last year, reported to the commissioners that it did as much work in one day, at ten dollars' cost, as the seven ton horse roller did in two days, at twenty dollars' cost each day; that is, the cost of steam rolling was a quarter of the cost of horse rolling. Reports of trials in England show that, in different places, the cost of haulage was from a third to half the cost of horse power. The differences of cost are due to the quality of roads, and the proportion of useless to useful work. In rolling, all the work is useful; in hauling, only the work of drawing the wagons is useful. If in a case in which the weight of the train is equal to the weight of the locomotive the cost should be half the cost of horse power for haulage, it would be a quarter of the cost of horse power for rolling. This is not allowed for in the accounts, because the carrier does not get paid for the rolling; but it should be considered by this club, because the influence of the club should be exerted in favor of the machine which is most advantageous to the roads.

The next that got to work in this region is the one designed by me. The design was modified by the builder, with a view to lessen the cost. The modifications consisted: 1st. In using a single engine, as Aveling and others do, instead of a double engine, as I designed it, and as Thompson and several other builders do; 2d. In omitting springs on the front end. The use of a single engine involved double gearing; that is, two shafts instead of one; in order that the engine might run with sufficient speed to make the fly-wheel effective in passing the dead points, and equalizing the application of power. And the double gearing involved a complication and weakening of the frame, so that it had to be made heavier to give the required strength; 3d. In shortening the machine, for the sake of "compactness," of which the customer was too desirous; and, 4th. In substituting cheaper valve gear for the link motion. These modifications, in a road roller, do no great harm; but in a traction engine I deem them inadmissible. In this I disagree with Aveling and several others, perhaps a majority of road locomotive inventors; but I agree with Thompson and several others, whose claims to confidence seem to me at least equal to those of the other party. Further on I shall adduce reasons in support of double engines.

Thompson's has but recently got to work, at Paterson. I had not seen it until yesterday. The report of a committee of the Farmers' Club upon it is decidedly favorable; and indicates, what is affirmed in numerous reports in English journals—some of them official—that it will work well on roads. The accident of getting mired in a soft spot, so that its ash pan touched the ground and stopped it, is not of much account, as such spots are unfrequent and may be avoided; and the ash pan can be put higher, or left off.

The distinguishing feature of Thompson's is the tires, which are of India rubber, five inches thick, covered with chains of steel plates, to protect them. The use of the rubber is to soften jolts and thereby prevent injury to the machinery; a further use, the prevention of crushing the road materials, is attained, especially and most notably when the rubber is not covered by the chain; but I think that the chain, even when backed by rubber, will injure the road more than the smooth roller in my engine.

Here is an engraving of this engine drawing a train of wagons. The wagons have common tires, and this circular of the American manufacturer recommends that the wagons be made with broad tires, and mounted on springs; and this, I believe, is the practice of the inventor. Now, so far as the rubber is good for the road, it is good for the wagon tires, as well as for those of the engine, and I presume would be used for them were it not for the cost, which is twenty-five pounds extra for each pair of five feet wheels. Where common springs can be used the inventor uses them; but between the engines and the wheels, where springs are inadmissible, he applies no springs, but puts the springs outside. Dr. Church, thirty years ago, and John A. Reed, of this city, ten years ago, did the same; but they used steel. Rubber is much better than steel for this case, and Thompson's improvement consists in this application of it. And it was obvious at a glance that he had solved the difficulty of reconciling the action of geared engines with the action of springs; and the only question was whether the cost would not be prohibitory. And this question is not yet satisfactorily answered. On the contrary, there is much presumptive evidence that their joint cost and fragility will render them too expensive for common use.

Here is Aveling & Porter's circular and list of prices. For an eight horse engine they ask $3,500 gold, $3,900 currency; and here are Thompson's prices: $5,000 for an eight horse engine; for a twelve horse engine (Aveling's) $4,500 gold, or $5,017 currency, and Thompson's is $6,500, an average difference of twenty-nine per cent in cost against Thompson's. Aveling's are the prices in New York, duty and packing paid. Thompson's charge boxing and shipping extra. Probably near a third more will be paid by the customer for a Thompson engine, and this I suppose is due chiefly to the greater cost of the tires; but the double engine accounts for a part of the extra cost.

Appended to Thompson's circular is an article from the London Times, in which it is said that "the India rubber tires for a twelve horse engine weigh fourteen cwt.," 1,568 pounds. The price of the best car springs is seventy-five cents per pound, which would make $1,176 for the rubber of these tires, the rubber being of the best quality. How much the steel chains cost I do not know, but I asked Mr. Hudson, superintendent of the Rogers Locomotive Works, if they would cost fifty cents a pound, and he answered yes, in a tone which seemed to indicate that he thought they would cost more. Some steel driving chains for Frye's fifty-four ton traction engine, built at Paterson, cost three dollars per pound. This comparison indicates that the difference of $1,483 between the prices is due chiefly to the tires.

A compensation for this extra first cost is expected in the greater durability of the engine. But will not this be offset by the cost of repairing the tires? The Engineer reports that at a late fair at Oxford one of these tires "burst." *The London Engineering* said the committee wished to see the engine work with the India rubber tires without the protecting chains, as was the practice in the early days of the invention. Their desire was complied with; and during the trial one of the rubber tires "snapped right across." And the chain itself is practical admission that the rubber alone will not stand the strains incident to the draft. *Engineering* adds: "Whether the ruptures would have occurred if the chain had been on, we cannot say."

As to the chains, Mr. John F. White, of Aberdeen, in a report of a year's experience with these engines, in daily regular work, says: "The repairs for the twelve months have been such as would be expected in the working of a new machine, exposed to such rough work. They have consisted chiefly in tightening the boiler tubes, replacing broken steel shoes and links, rejoining two splits in the rubber tires of the first steamer, which were too hard and non-elastic, and other similar work. The fracture of steel shoes, is now very uncommon, as a softer sort of steel is used, which stands better. The chains require to be tightened every other day. This is done by taking out a link or two, or a shoe bar where necessary. The wearing of the India rubber is scarcely perceptible; pieces have been torn out of the surface, here and there, by stones getting between the rubber and the shoe; but this does not seem to injure them to any extent."

It seems that the inability of the rubber to bear the strains, has been the subject of thought and invention, in England, where these engines have attracted much attention. *Engineering*, reports, that on the twenty-third of September, a trial was made of a five-horse traction engine, built by Aveling & Porter, which had segmental India rubber tires, attached to iron plates, by a new process. Each segment is twelve inches long, six inches wide, and three inches thick, attached to one-fourth inch steel plates, which are bolted to one-half inch wrought iron tires. They worked well. The advantage claimed, is, that if one breaks, it can be easily and cheaply replaced. *Engineering* concludes, by saying: "There is no doubt, a decided advantage in this method of applying rubber. Engines, with their wheels thus tired, will prove useful, under special circumstances, such as paved or uneven roads. But here, to our mind, their advantage ceases; and we believe, that this engine, or any of Aveling & Porter's engines, would work as well without as with this addition, and that in most cases, the £130 or £140 which these appliances cost, could be more profitably expended on the engine, in other ways."

The circular says, that "owing to their patent elastic tires, these steamers do not damage the roadway, or injure their machinery, when traveling over rough roads." And the article from the Times, says: "Perhaps its chief merit, from a military point of view, is the non-injury to roads. It is hardly possible to express this strongly enough, for not only does it travel over the roads, without the slightest injury to them, but it actually repairs and improves them. Some artillery officers were struck by this fact, when observing a steamer, with a heavy vehicle attached to it, having driven round and round in a field, thoroughly saturated with melted snow. The steamer left the merest track in the slushy ground, while the wheels of the vehicle behind, cut it into deep ruts. But as the engine passed over these ruts, when retracing the circle, it effaced them; and by-and-by, being detached, and run over the spot alone, it repaired the surface, and made it perfectly smooth and even. It was clear, therefore, that if steamers were engaged in hauling cannon, on whatever kind of road, a second engine, following in the path of the first, instead of aggravating the holes and ruts made by the artillery preceding it, would smooth them out, and restore the road to a good condition for its successors." This description, seems to refer to rubber tires, without the chains; in fact, the article is made up from several articles, some of which were published years ago, before the chain was applied; and it appears evident that this trial was with the bare rubber tires, and that the chains would not have smoothed the ground, as described. The plates of this chain, seem to be about four inches wide, and one-half thick, and one inch apart. Let them go over a thawed road, and then let the road freeze, and you would have a rather jolting road for a carriage; but the rubber, alone, would make it smooth. But, still better, a smooth roller would make it level, as well as smooth; it would crush the projections, and in a measure, fill up the holes. Rubber would leave the projections as it found them; for the Times says: "Bits of coal, potatoes, carrots, etc., have been thrown in its path, and after it had passed over them, they have been picked up uncrushed." The effect of the rubber, on a dry and rather hard road, would be negative merely, not injurious; but the effect of the roller, would always be beneficial.

I observed, yesterday, in the plow field, that the rubber tires were compressed one-fourth of an inch; and, on the race course, the ridges between the tracks of the chain plates, were about one-fourth of an inch.

On very soft roads and plow fields, there must be some penetration, even with rubber alone; the ground will be compressed, more or less, before the rubber will yield to the extent of its elasticity, so that the extent of bearing surface will be got partly by compressing the ground, and not wholly by flattening the tire, as it is got on hard roads. In such cases it is a question whether a roller five feet long, though rigid, will not compress the ground less than wheels twelve or fourteen inches wide, though elastic. I believe it will; and I think engineering is about right in urging that the chief use of rubber tires is on paved and rough roads.

On the whole, while I believe that Thompson's engine will work well on all roads, and will have great advantage on pavements, I believe that a roller will generally work better on common roads, and on natural ground. And the cheapness of cast iron, and its durability will turn the scale in favor of the roller engine. I admit that a rigid roller, or wheels, without springs, going fast over uneven pavements, will jolt so much that the machinery will soon be deranged; but if the motion be slow, the jolting will be less, and will amount to nothing serious at two miles an hour; therefore a roller engine that can run five miles on a soft road, may occasionally go over pavements, with no inconvenience but loss of time.

In regard to the other question, on which road locomotists differ, that of single or double engines, Aveling's circular says: "Single cylinder engines have proved themselves to be more powerful, less complicated, and in every respect better than engines with double cylinders." What is here meant by saying they are more powerful, is not quite clear; but Mons. Lienard, in an article on the French and English road locomotives exhibited in the world's fair in Paris, is sufficiently clear. He says: "With one cylinder the maximum effort is greater. This advantage is not to be disdained in a machine which is liable to get mired, and to require for a moment a strong exertion of force." As Mons. Lienard seems to represent the opinions of the builders, his explanation may be taken as if it were that of Aveling. Assuming it as such, I shall give it the examination required by the high position which Aveling justly holds in this branch of engineering.

It is the practice of locomtive and traction engine builders to make their cylinders just large enough to slip the wheels when the cranks are in such position that the engines work with their greatest force. Let us suppose that 10,000 pounds is the greatest force that can be applied at the rim of a wheel without slipping it, and that the gearing is proportioned so that 10,000 pounds pressure on the piston will give 10,000 pounds traction at the rim, when the crank is at 90°, in a single engine. In a double engine of equal power, each piston having 5,000 pounds effective pressure, and equal length of stroke, the maximum tractive force will be when the combined leverage of the cranks is greatest, which is at 45°, the combined leverage being thus 1.414. Multiplying this by 5,000, gives 7,070 for the maximum traction, against 10,000 for the single engine; and this seems to be the way in which this opinion has been reached in practice; that is, practicians have assumed a certain mean tractive force, say such as would be given by the single engine here supposed; and have then considered whether to use one cylinder or two cylinders each of half size.

But if we conform to the rule that the maximum effort should equal the maximum adhesion, we shall enlarge the two cylinders until their united effort at forty-five degrees amounts to 10,000 instead of 5,000 pounds. On each piston we shall have 7,070 pounds. The maximum effort will then be equal to that of the single engine; but the mean tractive force will be in the single engine 6,366 pounds, and in the double engine 9,001 pounds. Thus with equal power to start out of a hole, the double engine has 41.4 per cent more power to draw a load.

If we cut off the steam before the end of the stroke, say at three-fourths, in both engines, which is the usual practice in English locomotives, the lap and travel of the valves being such that no greater admission of steam is possible, the comparison will be more favorable to the double engine. The cylinders may be further enlarged until each piston bears 7,500 pounds pressure, and the power to draw a load will be one-half greater than that of the single engine: and this will be the practice; or if the single engine have its valve shortened to avoid this comparative disadvantage, it will not work expansively to so great a degree, and will therefore use more fuel.

In the single engine the power varies from 10,000 down to 0. In the double engine it varies from 10,000 to 7,500. If the single engine get stuck in a hole while on the dead point it may require 10,000 pounds help to start it, while the double engine can start from its weakest point, out of the same hole, with 2,500 pounds help; and where the single engine can start with 7,500 pounds help, the double engine can start without any help. Moreover, the strong and weak points occur twice in each revolution in the single engine and four times in the double engine, so that the help must be applied twice as far in the single engine before it can get into a position to dispense with help.

In ordinary practice the double engine will rarely need help, but the single engine often needs it. It is only when roads are drenched by rains that such troubles will occur to the double engine.

I trust that I have shown that with an equal load the double engine, at the worst, can start out of a hole as well as the single engine, and that in nearly all cases it can start better, and that it is not half as likely to get stuck fast. Nevertheless, it may sometimes seem that the double engine is the less able to extricate itself, because it can draw one-half more, and often will be made to do so; and if it be stuck fast with such a load it will fail to extricate itself, while the single engine, after unhitching, prying with starting bars, clutching and prying again, will walk away in lively style, and get credit for superior power, when in fact it has but two-thirds the power to climb a hill or draw a load through sand. Such is the seeming advantage of an unequal application of power. It limits the load so that with some delay and trouble to get it on its strong side it can get away with its light load; but if good judgment be exercised to limit the load according to the state of the road, the double engine may be worked at a third more tractive force in bad weather and one-half more in good weather than can be got with the single engine.

Another point in favor of the double engine is the friction of the valves and valve gear. Generally single engines run at twice the speed of double engines, the cylinders being of equal size; but the steam ports of the single engine must be twice as large, and the travel of the valve .414 greater. The total valve friction will therefore be as 3,535 for the double engine and 10,000 for the single. D. K. Clark, author of "Railway Machinery," estimates the friction of the valve upon its seat at .06 of the whole power. Mr. Adams, superintendent of the North London Railway, estimates it much higher, assuming a higher co-efficient of friction, and he computes that the friction of the valve gear is greater than that of the valve. Now the single engines of road steamers make more turns per minute than locomotives make. It is therefore reasonable to assume their per centage of valve friction equal to that of locomotives, say .06 for the valve and .06 for the valve gear, or .12 total, for the single engines, and .3535 of this, or four and three-quarters per cent, for the double engine. Thus it appears that seven and one-quarter per cent of the whole power is saved by the double engine.

Against this we must set the condensation of steam in the additional cylinder. But I never heard this computed at more than five per cent of all the steam, and if steam jackets be applied it will be much less than this.

The question of adhesion depends in a degree on that of double or single engines. Lienard reports that in '66 a double cylinder engine, with smooth tires, drew useful loads of fifteen tons; and no mention is made of slipping; and a single cylinder engine, with 14.8 tons load, slipped so that its wheels had to be provided with cross strips. I have shown that one-half more can be moved by the double engine. Now this one-half more is a fair, useful load, and will compensate for all the advantage that a single engine can derive from roughening its tires in the ways shown in Aveling's circular. It is a matter of opinion, at least the experiments do not warrant a positive conclusion; but I will risk my small reputation for judgment in this matter by saying that an engine with smooth tires and two cylinders, will draw as much as either of these will draw with rough tires.

But the best solution of this difficulty of slipping is to put the load on the driving wheels, as much as is necessary. In that case the drivers must be wide, to prevent cutting into the road. And the end of the widening will be to make a roller; and this is what I propose. Here is a design of an engine to move fifteen tons. It has a roller five feet high and five feet long. In front of the roller are the engine and boiler, and behind is a box for freight; and freight may also be put in front, when it is required to load the engine heavily. And the first vehicle drawn may be a cart, with half its load resting on the steamer; and in these ways the roller may be loaded to any extent consistent with the strength of the road.

This engine, having space for freight, will do light work without a wagon behind it, and will therefore be the more suitable for ordinary work.

This matter of rollers or wheels, smooth or rough, will be considered by the people, and will dispose them in favor of or against steam on roads. If they see engines that smooth and improve the roads every time they go over them, they will excuse considerable inconvenience, such as the frightening of timid horses; but if they see the road indented and cut into ruts, and otherwise injured, they will make the worst of every accident or inconvenience, and drive off the steamers if they can. We have all ridden over rough, frozen roads, and been badly jolted. Let us suppose that a roller should go over a half-thawed road, in the evening, and next morning it should be frozen; you would then have a smooth, hard, excellent road, until it was again thawed. Riding from such a road on to one that had been frozen while cut up and roughened, would soften opposition, and render steamers popular.

Not only the people, who do not use the steamers, will favor the gratuitous rolling of the road, but carriers will see that the train will be drawn more easily in consequence of the work of the roller; and if, for one trip, more power should be required, so that a straggling vehicle would not get paid for rolling, a line of wagons that went daily over a road would save in power and wear and tear more than enough to pay for any extra power that might be required for the roller,—if more should be required, which I doubt.

There is another point about Aveling's engine on which I differ from him; that is, the chain gearing. I use bevil gearing, and it works well. At any rate, the roller built from my design is liked better than Aveling's by the Schrimshaw Pavement Company, and by Mr. Martin, chief engineer of Prospect Park, who had charge of Aveling's roller, and was specially called upon to examine mine, with a view to decide which was best. Chain gearing is generally disliked by machinists; and even those who use it to transmit power from the second shaft to the driving wheels, do not use it between the first and second shaft, as they would do if it were better than wheel gearing.

As to the application of these engines to plowing, by direct traction, I will not venture to speak generally; but I believe that a smooth roller, five feet wide, will pack the ground less, and on the whole do better, than rubber and chain wheels twelve or fourteen inches wide. Of course the rubber tires may be widened, but that would add to the cost, to such extent as to make it inexpedient. Aveling does not propose to plow by direct traction, but says that by adding a clip drum, which can be removed at pleasure, his engine will be complete for tillage. A clip drum may be put on my engine, more advantageously than on his; because the driving shaft is at right angles with the line of draft of the plow. To make this addition, we should have to make the driving shaft in two parts, with a clutch to connect them; so that, by moving a sleeve along the shaft, the pinion which drives the drum could be ungeared, and the pinion which drives the carriage could be clutched. The engine would then move forward along the side of the field, as far as required, and the plowing gear would be reconnected.

I believe they all design to drive stationary machinery, if required. Mine can do it as well as the others. But the most convenient road engine, to drive stationary machines, is a common steam carriage. A ground wheel or roller, having been provided, the carriage driving wheels can be backed on to that roller, and the carriage held stationary. Its wheels will then drive the roller.

In the general proportion of the machine as a carriage, I differ from most designers. By this difference, I avoid more or less complexity. All the steam carriages built before my first experimental carriage, had their wheels loose on the axles, and one wheel had to be unclutched when turning a short curve. Mr. James Stone, long a resident in New York, who was Gurney's engineer, told me that he once ran against a turnpike gate, in consequence of attempting to turn when both wheels were clutched; and as carriages at that time were proportioned, it was necessary to loosen one of the drivers, when turning, to prevent the steering wheels from slipping sideways. But it seemed to me, that if the steering wheels were put forward far enough, they would have sufficient leverage to hold their ground, and force one of the drivers to slip. I tried it; and found that there was always sufficient steering power, unless the speed was so great as to give an excessive centrifugal force, on short curves. By running at low speed, around corners, we may steer securely with both drivers fast on the axle. And the advanced position of the steerers, allows them to be high, while the body of the carriage is very low. This places the center of gravity low, which is favorable to safety and to ease of motion.

Aveling's engine, represents the general practice in England, where roads are harder than ours, and can bear, or at least do bear, half a ton on each inch width of tire. On our roads, 500 pounds is as much as can be borne, without damage; we therefore require engines that have more bearing surface to their wheels. Thompson gets this surface, by his rubber cushions, which flatten, and press on more length of ground. I get it by wider wheels, or a roller. A roller sixty inches long can carry 30,000 pounds without injury to the road, but rather with benefit. Aveling assumes .3 adhesion for his single engines, and some assume .4, as the maximum adhesion, which would give about .25, for the mean traction of Aveling's, and .37½, for a well-proportioned double engine. If Aveling gets more than this, it is because he roughens his tires, a practice which is not allowed in France, and ought not to be allowed anywhere, because it injures the roads. If the roller be larger, say eight feet high, which is a good height for a heavy engine, a greater weight may be borne in each inch of width. I compute that the weight should be as the square root of the diameter; if 500 pounds per inch of width is a proper load for a five foot roller, 632 pounds per inch width is a proper load for an eight foot roller; and 53,088 pounds may be its weight for adhesion; and three-eighths of this, about 20,000 pounds, will be its mean tractive force when in full gear. At two and a half miles an hour, working 11½ hours a day, a horse draws with a force of 83.3 pounds; hence a roller locomotive, with this weight on its roller, or about 62,000 lbs. total weight, will do the work of 240 horses. And this work will be wholly useful in road making, and it ought to be reckoned wholly useful in hauling heavy loads on gravel roads; for it would constantly repair the damage done by horses' feet and the narrow wheels of common vehicles. But as there is not now any regulation by which the carrier can have his tolls or his road or license tax abated to pay him for benefiting the road, we must deduct a third for the work of moving the engine. This will leave the disposable force of 160 horses for drawing wagons.

In plowing, the resistance to rolling is twice as much, in some cases more; and the packing of the ground is more or less injurious, instead of beneficial; we must therefore reduce the number of horses to eighty, and on some lands less. Some will say that such an engine will hardly go alone on much of the land that has to be plowed; but such assertions are not based on the trials of the best traction engines, and are usually the mere conjectures of men who have not studied the subject at all. As compared with horse power, I have no doubt that locomotive traction will be cheaper, on all kinds of ground; but whether it will be cheaper than rope traction by steam I am not prepared to say. In England it is proved cheaper than traction by the engines they have tried; but they have not tried double-engined rollers; and they have the advantage of low wages, which is favorable to rope traction. Seven men, or six men and two boys, are employed to plow with an engine of fourteen nominal horse power, by rope; half as many would do more work with a traction engine. And since Thompson's engine has come out, opinion in Scotland seems to lean much in favor of locomotive traction. But a locomotive can plow with the rope on soft ground, and by direct traction on hard ground; and it may be that both methods will be practiced.

Now an engine of this kind can work for twenty dollars a day, doing the useful work of eighty horses in a plow field, or 160 on a road; and fewer men will be required to work it than are required to work horses. As to cost of a double engine, I believe it will not be much greater for equal weight. The double gearing, and extra work on the frame, very nearly if not quite balance the cost of an additional cylinder and its connections; and for equal work, I am confident the double engine is the most economical. If, however, any customer should prefer a single engine, and will not be convinced by all I can say, I will cheerfully accommodate him, as I did in a former case. And as to prices, I think they will be about equal to those of Aveling; but that will soon be determined by a builder's estimate, whenever an order is proposed.

One more point should be mentioned. Both Aveling and Thompson and most traction engine designers, have changes of gear, to run at different speeds. This may be in a measure necessary for a single engine, in order that, when it runs slowly, the fly-wheel, in consequence of its high speed, can get over the dead points. But in a double engine it is a useless complexity. If a change of speed be necessary anywhere, it is where the resistance varies most, and that is on railways with steep grades; yet it is not used there. At the speed of freight trains, say fifteen miles per hour, the resistance is one in 190 on a level; and a grade of one in 190 doubles the resistance.. On a common road the resistance is one in fifteen; and a grade of one in fifteen is required to double the resistance. And, generally, the grades on railways increase the resistance in a greater ratio than the hills on common roads increase it. The cylinders, which are just large enough to slip the wheels, without change of gear, are not too large for economy on levels. They will not expand the steam beyond the limit which has been proved advantageous in practice.

Since I wrote the foregoing, I have seen Thompson's three-horse engine draw plows and wagons, and run alone at a fair stage-coach speed, on a soft race-course. It drew seven ploughs, which seemed to me ill-shaped and dull. Their mould boards were more bluff than those of the plows in the fair. The depth of furrow was eight inches, and the aggregate width plowed was eight feet. It was, as nearly as I could judge from long recollection, full work for seven yoke of oxen; and the speed was about one-half greater than that of oxen when worked all day. But the work seemed to me too much for so light an engine. Probably this was owing to more than average wetness of ground. The engine stalled several times but by backing a little, to slacken the chain, so as to give a strong jerk, it started again, without much loss of time, except in one case, when the ash-pan got against a hillock. The engine was made for roads, and the ash-pan was but four and a half inches clear of the ground, on a hard surface; and there was not ready access to dig away the ground, to relieve the ash-pan, but the engine had to be lifted, and sticks put under the wheels; it then started readily. All this trouble can easily be avoided, as I have before suggested. But I would recommend a ten or twelve horse engine for such heavy work, so as to have a surplus power for emergencies; and so as to work the steam at a rather high rate of expansion, which would save fuel. Or a smaller gang of plows might be used; but there is a limit within which it may be inconvenient to narrow the plowing; and that limit seems to be the width outside the wheels. Five feet, I judge, is as narrow a strip as is expedient to plow. This would require a gang of five machine plows, as I am informed.

After seeing this trial, I do not hesitate to say that I believe this engine will work more economically than horses for plowing, and that its work will be better. The packing of the ground does not appear to me to amount to much, not so much as the lumps made by horses' feet. I asked a farmer who was present what he thought on that point; and he said decidedly, that he did not perceive the effects of the packing in the ground plowed, and did not regard the matter as of any consequence. All the small interruptions would have been avoided by leaving off the ash pan when on the field, that is by making it movable, and by giving the engine the work of ten oxen, instead of fourteen. And it is a very important advantage that a steamer can work day and night, at least twenty-three hours per day, through the whole plowing season.

As compared with the rope traction system, I am unable to say what its economy will be. Where wages are very low, as in the agricultural districts in England, it may not be so economical as here, where wages are high; but I have a strong impression that here the locomotive system will be much the cheapest. A man and a boy can work the engine; and the plows seemed to need no management, except at the ends of the field; but with rope traction, seven men are required to attend fourteen nominal horse power. If we work with a larger engine, say twenty horse, two hands can work it. The saving of wages will, I believe, decidedly turn the scale in favor of direct traction. But if this be an erroneous opinion, and rope traction be best for general plowing, there are probably some lands on which the locomotive will be preferable; and an engine that can do road work can certainly be so made as to turn a clip drum quite as well as a rude portable engine can turn it. I don't precisely recollect the difference of cost between the locomotives and the horse-drawn portables used in England, but I think it is about forty pounds; it is so little that engineers deem their superiority worth more than their extra cost. It is therefore certain, to my mind, that a locomotive is the best engine to buy for farmer's work.

In closing this paper, I think it well to give you the confirming opinion of Sir Joseph Whitworth, as stated in his recent address to the Society of Foremen Engineers. He says: "The cultivation of land by steam power is greatly on the increase, landed proprietors now seeing the importance of so cleaning and improving their estates as to admit of it. The use of horse tramways is being urgently pressed forward, and a large outlay is contemplated. In my opinion they are not suited to the present times; and mechanical engineers have a right to enter their protest, considering the heavy obstructions these have been for many years past to the employment of road locomotives. If toll gates were abolished, and each county had an organized staff for making and keeping the roads in good order, using the steam roller, steam sweeping machine, and other necessary appliances, mechanical engineers could then, I have no doubt, produce a small light locomotive that would do its work most effectively. The consumption of fuel per horse power is now so small that road locomotives could be employed at far less expense than the overworked horses we now see, while pedestrians, and those who keep horses for pleasure, would have good roads; and many gentlemen, no doubt, would have their well made locomotives. Under any circumstances, good clean roads are the most profitable, when everything is taken into account; but, unfortunately, those who make and repair them generally consider only one side of the question." Whitworth is by many authorities deemed the best mechanical engineer in England; and he has probably seen and examined the machines he speaks of, so that his opinion may be accepted as deliberate, and sufficient to assure less skilled judges that the subject is worthy of attention.

After a short discussion on Mr. Fisher's paper, a new lightning rod was exhibited. Its construction was not generally approved.

Adjourned.

November 17, 1870.

Professor S. D. TILLMAN in the chair; ROBERT WEIR, Esq., Secretary.

The Chairman read the following notes of scientific progress:

I. FIXING PENCIL WRITING.

W. Wolanek states that when paper on which are drawings or writings made with the common plumbago pencil, charcoal or chalk, is painted over on the reverse side with a moderately strong solution of bleached shellac in alcohol, such drawings or writings become fixed so thoroughly that they cannot be rubbed off.

Dr. J. W. Richards.—There is a much more simple way than that. When you write with a pencil upon paper wet the writing with the tongue and it will not rub off. Saliva acts as a sort of paste.

Dr. J. J. Edwards.—The old mode was to dip the paper in skim-milk, and let it dry. If the paper is well sized, you have nothing to do but to pass it over the steam from the spout of a tea-kettle in order to fix the writing as thoroughly as by any other process.

II. OZONE AND PICRIC ACID.

Experiments made by Abbé Moigno show that it is dangerous to experiment with products resulting from the action of nitric acid upon complex organic substances which contain nitrogen only loosely bound. He found that when carbazotic or picric acid is introduced into a vessel containing ozone, instantaneously a violent explosion takes place.

III. ELECTROLYTIC IRON IMPURE.

Some time ago the Russian chemist Jacoby obtained, by electrolysis, iron which he supposed was absolutely pure. Recent experiments made by Klein, prove that the iron deposited by an electric current contains a large quantity of hydrogen.

Dr. P. H. Vanderweyde.—I have given some attention to the absorption of gases by metals. We have long known that oxygen is absorbed by silver. In the process of cupellation, when the silver becomes pure, it must be withdrawn from the furnace with care, in order to let the oxygen slowly escape. Platinum will absorb oxygen if we heat it to a red heat and allow it to cool in dry air. And if we expose platinum sponge which contains oxygen to a jet of hydrogen gas, the platinum will become red-hot and the jet of hydrogen will ignite. Palladium will absorb nearly a thousand times its own volume of hydrogen gas if exposed to a violent red heat; and the palladium swells up from the absorption of the hydrogen, but returns to its original volume when the hydrogen is expelled. Mr. Loew, assistant in Professor Doremus' laboratory, has caused mercury to absorb hydrogen gas to such an extent that it became so light as to float upon water. Professor Klein finds that iron deposited by electrolysis contains hydrogen. It is evident that as it is deposited the hydrogen must go with the iron and the oxygen to the other electrode. I have examined iron used in medicine and supposed to be pure, but I found it to contain hydrogen in large quantities. The only way known to get absolutely pure iron is to deposit it by a battery. This iron will contain hydrogen, but if we remove that hydrogen by heat we can get pure iron. Chemically pure iron is a very different metal from what we have supposed it to be. It is soft like lead. It is white like silver. All the iron we know contains impurities and alloys, traces of carbon, and a great deal of hydrogen. Titanium is often combined with it in ores. What was supposed to be pure titanium is now found to contain about eighteen per cent of nitrogen, by weight, corresponding to 600 or 700 volumes of nitrogen gas. Some chemists assert that iron absorbs nitrogen from the air, and that the good quality of the steel obtained in the Bessemer process arises from the small quantity of nitrogen absorbed in the blast by the iron.

It has been asserted hydrogen is metallic because it makes alloys with the metals. Hydrogen will take the place of a metal in almost any metallic compound. But if hydrogen is metallic because it is absorbed by metals, then oxygen and nitrogen are metals too. They also are absorbed by metals. Nobody considers oxygen a metal. But absorption does not prove anything in that respect. We must distinguish between combination and simple absorption; and we must remember that in an alloy, not in absorption, we shall have the metallic nature.

IV. ASPHALTE.

The London *Mechanics' Magazine* says if there is one point upon which the public require to be undeceived, it is respecting the nature of asphalte. The common idea of asphalting a piece of ground is to get some gravel and some gas tar, heat the tar and mix them together, and pay the ground over with it. Nothing can be more erroneous, more unsuitable to the purpose and more unsuccessful. If there is one circumstance more than another that has contributed to give asphalte a bad name, it is spurious imitations of it that have been adopted by local boards, corporate authorities and private individuals. After trial, it has been condemned, and the whole principle denounced from the failure of examples into which the true principle never entered at all. Asphalte, then, in the correct sense of the term, is a natural production, and is brought to this country in the form of amorphous masses of rock, from which it is extracted by the action of heat and mechanical means. Such is the asphalte of the Val de Traverse, and likewise, such is the well known Pyrimont Seyssel asphalte, although there are some points of difference between them after they have undergone their respective manufacturing processes. The asphalte in question, when laid upon the bed previously prepared for it, is in a state of an almost impalpable powder, of a dark snuff color. It is then, while hot, pounded or punned gently, and when the operation is finished it presents the appearance of a solid, smooth, homogeneous mass, without the smallest crack or crevice of any kind. Its thickness is about a couple of inches, which it is stated is sufficient to enable it to last, with the ordinary amount of repair, for ten years. There will certainly one reflection arise in a person's mind when he stands upon a freshly prepared surface of asphalte. It is that it is a radical error ever to think of breaking it up for the purpose of laying new pipes, or mending old ones, or for any purpose whatever. Unfortunately we have not arrived at the proper degree of metropolitan government, which should build subways and compel them to be utilized. We shall be very much surprised if a week passes away after Cheapside and Poultney are again opened for traffic, without witnessing some of the employés of some gas or water company hard at work breaking up the smooth road, possibly enjoying the job all the more on account of its novelty and the consciousness that they are defacing other people's work. It is quite time such stupid and unnecessarily expensive proceedings were put a stop to, and pipes and drains laid where they can be got at without spoiling our thoroughfares and impeding traffic. The suggestion of the *Mechanics' Magazine*, that gas and water pipes should be laid in such position that they can be reached for repairs without seriously interfering with street traffic, is one well worthy of attention of those in authority in nearly all our American cities.

Dr. P. H. Vanderweyde.—That is done in Paris to a great extent. The gas pipes and water pipes can be reached without taking up the pavement. Good asphalte is well adapted to streets where it is not exposed to the heat of the sun; and it will stand almost any amount of wear and tear. But here they mix it with coal tar.

Dr. J. J. Edwards.—This city now has sewers which a man can walk in. If we had two such tunnels as we now have we should have ample room for the pipes for sewerage, and for the gas and water pipes, all of which would be accessible without taking up the pavement. The ultimate cost of this plan would be less than that of the present plan. Asphalte has been used from time immemorial; but it is the most treacherous material that can be used in painting. It is acted upon by the atmosphere, and I have always associated it with disintegration.

Prof. J. A. Whitney.—I have seen, in San Francisco, what is there called asphalte, used for sidewalks, and for their climate it is found to answer extremely well. But the sunshine in the streets of New York would make it pasty and soft. I am sorry to see so much of this coal tar poultice applied to the streets of New York.

Mr. J. K. Fisher thought the difficulty in this city was the want of intelligence in regard to these matters in the city government. If they had among their own number, or would listen to, civil and mechanical engineers, we should have a system of culverts for the sewer pipes, water pipes and gas pipes, and then it would be practicable to have good pavements.

Dr. Vanderweyde.—Asphalte is only liable to decay when used as a paint, in combination with oil. There are two kinds of asphalte: one called bitumen, and the other very soft.

Dr. Edwards.—The asphaltum used in the Egyptian mummies is also used in the arts, and in picture painting, and called "mummy." But although that lasted in the climate of Egypt, it may not last in our climate.

Dr. Vanderweyde.—The ruins of the tower of Babel show that asphalte was used in the place of cement to put the stones together.

Prof. Whitney.—We can go back further than that; for Noah's ark was "pitched within and without." In California they make water pipes from cloth rolled upon a mandril and saturated with asphaltum. Paper pipes, made in the same way, have been used in drainage, and are recommended by Mecchi for that purpose. The Trinidad variety of asphaltum is now imported in considerable quantities, and is used for asphalte roofing. Coal tar is boiled down and used for the same purpose.

Mr. Hudson.—The asphalt pavement in Paris has stood the test of 104° in the shade, where the sun has been shining upon it nearly all day.

SPECIMENS FROM TEXAS.

Mr. Rees exhibited specimens of tarantulas and other animals from Texas, preserved in alcohol. Also specimens of stalactites, much resembling petrified wood.

Prof. Whitney stated that he had seen, in California, small fish, which were represented to have been thrown up by an artesian well.

Prof. Vanderweyde said that artesian wells sometimes threw up fish, but they had no eyes.

Prof. Whitney.—These fishes had eyes.

Prof. Vanderweyde.—Then they did not come from the well.

Prof. J. Darby said that the fishes of the Mammoth cave and the blind fish thrown up by artesian wells are inhabitants of the interior of the earth. But artesian wells also throw up sometimes fresh berries, and fish that are not blind, which have followed the streams through the crevices in the strata, and thus have reached the interior of the earth.

SAFETY COAT-HOOK.

Mr. O. Nicholson exhibited a safety coat-hook, intended to lock the coat hung thereupon, so that it could not be removed except by the owner.

The President exhibited the pocket spectroscope, manufactured in New Jersey, referred to by him at a previous meeting.

PREPARATION OF ALIMENTARY SUBSTANCES.

Prof. J. Darby delivered a lecture upon food and its preparation.

There are two classes of alimentary substances, which have very different applications in the system. One class contains nitrogen, with the other common elements, oxygen, carbon and hydrogen; and the other class contains no nitrogen. By some the nutritive power of the second class has been denied. At any rate, the class containing nitrogen is the most important. It is this which makes our flesh, our brain, our muscle, our nerve. The other class makes fat and similar materials in different forms. All these nutritive bodies come originally from the vegetable kingdom. The vegetable contains all that the animal contains. We find the nitrogenous elements in everything that will nourish us. Every plant contains nitrogen. There can be no life without it, and it communicates life. It cannot be transferred from one plant to another, but can be transferred from the plant to the animal, and from animal to animal, and continue in the series until it is worn out and becomes useless. Those materials which are nitrogenous in the vegetable kingdom, existing in the grain, etc., are generally divided into three kinds of matter: Albumen, casein and fibrine. These three substances exist not only in animals, but in vegetables. Take the juice of any plant, as the juice of the beet root, or apple juice, press it out, and it is perfectly clear. In a few minutes it will become turbid, owing to the deposition of the fibrine in it. After it has become clear, boil it and it becomes turbid again from the coagulation of the albumen. After the fibrine and albumen have both been separated, apply an acid and it will become turbid again from the casein.

There are other nitrogenous materials in the animal system, but they are not nutritious. One of these is gelatine. Blanc mange and similar articles of food are prepared from gelatine, and are supposed to be nutritious, but it has been satisfactorily shown that they contain no nutriment at all. Fibrine, casein and albumen may be reduced to a substance exactly identical, which is called proteine; but we cannot convert gelatine into proteine. Its composition has been altered; it has been oxygenized and gone past the living point. It is like the elements of the body which have performed their work and are ready to be rejected by the system.

Papin's digester was much used in England at one time, and is still used in hotels, for softening bones and making soups. By applying a high degree of heat, a large amount of gelatinous matter is extracted from the bones, and this is used for soup. At one time Papin's digester was introduced into France, and the poor were supplied with broth, etc., prepared by its aid. But the results induced a suspicion that, whatever nourishment the broth or soup contained, was not increased by the addition of the gelatine. It was found in the hospitals that patients fed with gelatine were often troubled with marasmus and other similar complaints.

In order to decide the question, some of the most eminent French physiologists experimented in this way: They took three dogs and placed in such confinement that it could be certainly known exactly what aliment they had. One was fed with pure gelatine, and the other two with gelatine and bread in different proportions. The dog fed on gelatine fell away rapidly; and the dog fed with the smallest proportion of bread also fell away, but not so much; while the third did not fall away at all. They then gave each dog nutrition, with an exact record of the amount given to each, and with different proportions of gelatine; and it was found that their increase was exactly in proportion to the nutrition given, irrespective of the gelatine. They multiplied the experiments, and the result was a demonstration that gelatine has no nutritive power. Yet there are tons of it sold in this city for food.

Perhaps nothing among civilized nations exerts so great an influence over the happiness and welfare of the human race as cooking. In cooking our food we accomplish two or three things. We are omniverous; our teeth show this, for we have the cutting, the tearing, and the grinding teeth; our digestive apparatus also shows it. Now the hardest things to digest are raw grains. We have not the large stomachs of the purely herbiverous animals, and to compensate for this we have cooking; a great part of the digestive process is carried on in our kitchens, and not in our stomachs. It is very difficult to get starch to assimilate, and starch constitutes a large proportion of the substance of grain. By roasting or cooking, we break up the starch grains, and accomplish a great part of the work of the stomach by breaking them up and making them soluble. We can hardly digest a raw potato, but we can digest it very easily after it is cooked, and the starch has been broken up and made soluble.

With fruits the case is different, because they do not contain much starch; they contain a large quantity of sugar; their materials are nearly all in a soluble state.

There is a curious relation between the eating of meat and the eating of starchy food; if meat is eaten with starch, the starch will be digested sooner than if eaten alone; bread and butter will not digest so soon in the stomach as bread and meat; the presence of the meat accelerates the conversion of the starch; bread and meat, therefore, should be eaten together. Nature prompts it; philosophy prompts it; chemistry prompts it. Meat needs cooking; it should be heated enough to coagulate the materials, so as to make them easily assimilated by the gastric juice. The earliest mode of cooking meat was by roasting; even as late as the time of Homer we have no account of anything being boiled. Abraham probably brought that art from the Egyptians, for we read that Jacob gave pottage to his father.

It was said by a French politician that a diplomatist should always have a good cook; that diplomacy and good cookery went hand in hand. If he gave good dinners, those whom he wished to influence would be in a good condition to be worked upon. A dinner well prepared makes us feel happy and comfortable; but a bad dinner makes us touchy and unable to bear things that we otherwise would.

No nation has carried the science of cooking so far as the French. The Lacedemonians were abstemious, and cast aside all delicacies. It has been said: "No wonder they were so brave, for it was much easier to die than to live on the black broth of the Lacedemonians." At Athens they carried cookery to a high degree of perfection, and even their kitchens were adorned with paintings and statuary. The Romans, in their early history, were very abstemious, but as the empire extended they became very luxurious. In a feast given by Lucullus, six hundred ostrich brains were prepared in one dish, and three thousand tongues of singing birds in another. They raised oysters whose shells could hold gallons.

High living if rightly controlled is not an evil; but the bad preparation of the food we eat is, and sometimes the too great quantity that we eat. The downfall of Rome can be written in one word—cookery. They became voluptuous, lazy and effeminate, and were unable to withstand the hordes that came down upon them. About the thirteenth century the Crusaders brought back with them the luxuriousness of the east, and the extravagance became so great that the king issued an edict against it. At one feast there were twelve tables, seven courses at each table, and at each course one hundred and forty silver plates. In one case sixteen birds were put one within another, the last being a turkey. Each was prepared beforehand, and when all were ready, and in place, it was put into a vessel over a slow fire, to digest, and not to boil, and remained sealed up for twenty-four hours. There was the concentration of all the materials of sixteen birds in one, and all the spices in one. There they had all the bird taste that could be produced, and all the condiment taste that could be produced, concentrated in one dish.

When Cadmus brought letters to Greece, he came as a cook from Sidon. A good cook should always be, if not literary, at least a good chemist, a good botanist, and a good physiologist. Peggy, and Judy, and Maggy place on our tables, day by day, compositions that even an ostrich would reject, indigestible and sometimes poisonous, and if we have headaches or diseases, we call it "a mysterious dispensation of Providence," when it is a dispensation that comes from having an ignorant cook. There is such a thing as having a luxury and having it right; or there may be poison in a buiscuit. Every lady that controls a household should have a knowledge of everything that occurs within the bounds of her kitchen, and should perfectly understand and control the preparation of food for her family.

Dr. J. W. Richards.—Plato's definition of man as a two-legged animal without feathers, has in modern times been replaced by another, that man is a cooking animal. The disease trichina results from eating uncooked pork, and the only reason why we do not have it here as much as they do in Germany is because we cook the pork more than they do. Nitrogen is stated to be an essential ingredient in our food. Every human being has in his system nitrogen, salt; fluorine in his teeth, phosphorus in his bones, even though they may live for years upon vegetables without salt. Where do they come from? Partly from the food; but I think there is some process by which nitrogen is obtained from the atmosphere through the respiratory or cutaneous surfaces.

Professor P. H. Vanderweyde.—Experiments have established the fact that not a particle of nitrogen can be appropriated by the animal from the atmosphere, through respiration of the skin. Some late experiments commenced under Napoleon, and stopped by the war, upon plants fertilized with artificial manures, and enclosed in large glass cases in which the air was made by art, so that its elements were accurately known, demonstrates that certain plants, such as beans and peas, take nitrogen from the air, and others, such as wheat, take it only from the soil.

Adjourned.

December 8th, 1870.

Prof. S. D. TILLMAN, in the chair; ROBERT WEIR, Esq., Secretary.

TIN-WARE.

Mr. T. D. Stetson described the improvements which have been made in the mode of manufacturing tin-ware, by striking up the metal into the desired shape, instead of forming it of separate pieces soldered together. By this improvement a tin pan, for instance, is formed of one piece of tin, without seam, instead of two or three, difficult to keep perfectly clean and liable to leak. Heath, Smith & Co., now produce pans of a single piece, with the sides absolutely perpendicular, the same kind of a job as in making percussion caps. It is easy enough to make dies and to bring force upon them; one of the main troubles is, that in bringing the die down the metal crinkles or buckles up. This is avoided by cutting out the tin of the proper form, but sufficiently large to afford a rim, upon which a ring of metal presses with sufficient force to prevent the buckling, but not sufficient to injure the tin. The problem is to hold on to this rim enough, and yet to allow the tin to slide and yield to the die. The method adopted is to bring hydraulic pressure to bear upon the ring, and independent hydraulic pressure to force down the die, the two being regulated at pleasure. The result is that the tin is not stretched materially in the process, but the part near the rim is made, as in upsetting, thicker than it was before. The angle is curved to a radius of about an eighth of an inch, to keep it from cracking. The outer edge is trimmed off and a stiffening wire put in in the ordinary way. Grimshaw's patent substitutes for the single die a series of dies, bringing the metal more gradually into the desired shape. A somewhat similar process is used in making dish-shaped vessels of boiler iron half an inch thick. In that case the metal is heated, and the press is so constructed that it can be brought down rapidly into contact, and then a powerful pressure applied.

Mr. Fisher stated that three or four years ago, a vessel about eight or nine inches in diameter and of the same depth, was made of Bessemer steel, by pressure, cold, without any flaw.

Mr. Stetson suggested that that might have been made by "spinning," or applying the pressure while the plate or the die revolved; for, after the expense of making dies for one had been incurred, they would have made more than one.

The Chairman introduced Col. John E. Gowan, a distinguished American Engineer, favorably known by his successful efforts in raising the Russian fleet near Sebastopol, who read the following paper:

On Ship Raising and Carrying Ships over Bars.

Mr. Chairman and Gentlemen: It is with no small amount of diffidence that I appear before you to-night to read a paper upon my experience in raising sunken vessels, in order to show you that the same principle I then worked upon may be applied to the safe and speedy conveyance of vessels of the largest tonnage over bars at the mouths of rivers; but I feel you will accord me your indulgence and sympathy when I tell you that it is only the fourth time I have lectured upon any subject, and the first upon this, and you will readily agree with me upon the wide difference between my present position and the one I have occupied in the conduct of those submarine operations to which the greater portion of my life has been devoted.

From time immemorial the process of raising vessels in a tideway, by means of the rise and fall of the tide, has been considered the only certain method of effecting that end, and my system is purely a practical application of the principle therein involved, with the single exception, but not an unimportant one in the economy of time, that I am altogether independent of the tide. A few of the methods hitherto tried are as follows:

In Holland a machine was used for raising ships by the buoyant power of water, called a camel. It is a very ingenious contrivance, and consists of twin hollow vessels, so arranged that they can be applied on either side of a ship's hull. They are made water-tight, and on the deck of each, windlasses are attached, by which ropes passed under the keel of the vessel are worked. Each half of the camel is allowed to fill with water, which sinks with the weight, and when the ropes are adjusted the water is pumped out, and the buoyancy of the hollow vessels lifts the ship out of its bed at the bottom of the stream.

The largest man-of-war in the Dutch service, Cressy says, could be floated over the sandbanks of the Zuyder Zee by means of this machine. It was invented by Bakker, at Amsterdam, about the year 1688, and has been used at Venice, on the Tiber, and elsewhere, with success.

Bonvaux and Goubert, eminent French engineers, also contrived to raise vessels which had been sunk twenty-four and forty-two years respectively, by means of elaborate processes, which it is now needless to describe. Nor is it my intention here to enter very fully into the various schemes which have been brought forward; some partially successful, some totally impracticable, and others never yet tested. Suffice it to say, that for a number of years the question has been one of profoundest thought to me, and I believe there are but few, if any, of the tested or suggested methods which have not come under my inspection, while many of them I have myself employed with varied results.

About the year 1849 an invention was submitted to the United States government, having for its object the raising of vessels by means of air-tight cases, composed of several thicknesses of canvas and India-rubber, with a strong netting on the outside. Upon a trial which took place, with a view of ascertaining the value of this invention as a means of bearing a vessel over a river's bar, it is notable that a sloop-of-war in Baltimore, having a number of cases attached (if I recollect right, twenty on either side), was only raised some eighteen inches. Government, however, purchased the apparatus, and soon discovered that for the intended purpose (viz., the raising of submerged ships) the method was a total failure. I shall subseqnently have occasion to refer to an instance in which I also met with the same results.

Other and very costly apparatus has been designed for raising vessels by powertul hydraulic pressure ; but I am not aware that either of such modes has been practically tested, and those I have seen in models are open to serious objections for practical working, though in theory they are all that may be desired. But as I said before, it is not my intention, even if time permitted, to critically discuss the schemes of others, but rather lay before you some of my own experience and an explanatory statement of the method which, after a long course of disheartening failures and obstacles overcome, finally enabled me to achieve the most perfect success.

About the year 1845, the United States steam frigate "Missouri" was burned and sunk in the bay of Gibralter, causing an obstruction which was the subject of complaint by the British government. Upon its representation, the United States government undertook to remove her, and in varions ineffectual attempts expended no less a sum than $100,000, the engineers employed reporting that it was impossible by human ingenuity to effect the desired end. In 1851, upon a second application from the British government, it was resolved to make a further attempt, and I was honored with a commission to carry out the project. I found the vessel (a first-class war steamer) sunk in about six fathoms, and laid over broad on the bilge, having about three fathoms clear over all, and completely covered with sand. Government had forwarded twenty of the before-named air bags for me to test, which I accordingly did, and succeeded most effectually in bursting up the greater portion of them without getting an aggregate lifting capacity of nine tons, and this happened generally before they were half inflated, though each bag or case was supposed to be equal to more than five tons. I at length concluded that the only effectual means of removing this vessel was by exploding gunpowder beneath her keel, which I did by the following process:

I directed the construction of pointed cast-iron cylinders, some seven feet in length, fourteen inches in diameter, and one and a half inches in thickness, having three turns of a screw cast on the point (similar to a screw file) filled with gunpowder, and closed by caps secnred with screw bolts.

These cylinders were placed outside the vessel in such a manner that on being driven through the sand some thirty feet they would arrive beneath the vessel's keel. To effect this I used a shaft of wrought-iron, constructed to fit over the head of the cylinder. This shaft worked on a raft on the surface of the water and was turned down in the same manner as the screw pile now in use, so that by its means the cylinders were placed in the required position, and the shaft being removed, were exploded by electricity. The vessel was in this manner broken up, and raised piece-meal, and the obstruction entirely removed. In token that the operation was peformed to its complete satisfaction, the British Government presented me with a certificate to that effect.

Shortly after this, in the year 1854, my attention was called to the steamship "Erie," burnt and sunk with great loss of life on the lake of that name. She lay in about ten fathoms, and several attempts had been made to raise her, one of which was by means of "Bishop's Floating Derrick's." Report alleged that the vessel contained about $400,000 in specie, and thousands had been spent in fruitless endeavors to raise her to the surface. However, it seemed to me to be anything but a hopeless task, and, with very little difficulty, I managed to raise her entire by means of chain-falls working from two open trussed frames, the ends of which rested upon bulks on either side, and towed her into Buffalo creek, hauled her ashore and cleared out her contents, and a mass of amalgamated metal supposed to be gold and silver, which appeared to be such a rich harvest that I refused an offer of $50,000 for one-half share. Taking the metal to New York, it was submitted to assay, and I was informed that six days would be required to make the investigation.

On the morning appointed, however, when I attended with some friends to learn the extent of my good fortune, I found, to my suprise and chagrin, the result of the assayers six days' labor was the production of two small bars of silver, valued in all at about $750 and that my supposed gold was transmuted into the less precious, though very useful, metals which had composed the connections and fittings of the engine of the sunken vessel.

Did time permit, I would call your attention to various other experiences and experiments prior to my undertaking the operations in Sevastopol harbor, which laid open to me a system by which vessels of the largest size may be lifted from the depths of the sea and borne expeditiously and unharmed into their destined port. In the year 1856, I received a communication from the Russian Minister at Washington, to the effect that his government wished to negotiate with me for the raising of the sunken fleet at Sevastopol.

On his further invitation, I at once proceeded to Moscow, and through Prince Gortschakoff, had an audience with his Imperial Highness Duke Constantine, then Grand High Admiral of the Russian navy, who requested my judgment of the practicability of removing from Sevastopol harbor the numerous and formidable obstructions which the past policy of the Russian government had created. Having already given the matter most serious reflection, and settled upon the only plan which to my mind bore a probability of success, I submitted to his Imperial Highness plans of docks or caissons of which I approved, and he at once desired that I would enter upon the work proposed.

Familar acquaintance with the difficulties surrounding such a task increased the hesitation I felt in undertaking at all a labor of such magnitude and importance; but ultimately, at the urgency of the government, I accepted the contracts on terms subsequently materially altered, which resulted, on account between us, in a balance of about $250,000 in my favor; and in the spring of 1857 I arrived at the scene of those labors and operations, which were to extend over the five following years.

I may here state that the Minister of Marine at St. Petersburg sent me about twenty of the camels, or balloon-bags, somewhat similar to those which had exploded under my hands in the bay of Gibraltar, and with these I again experimented, but with no better fortune than on the former occasion, and I finally threw them aside as practically worthless.

Making no further comment upon the many theories propounded on the subject before me, but confining myself strictly to a statement of my system and its results, I will at once proceed to an explanation of the appliances I used, and their method of operation. In the first place, I had intended to make use of four floating docks (as I prefer to call them), on a smaller scale than those shown in the diagrams; and I may be better understood when I state that, on being tested, these four docks had an equal lifting capacity with two of those I am about to refer to.

They were designed to lift, by chains through center well-holes, upon which plan my first attempt was made. It was, of course, obvious to me that such a process must bring the docks together as the vessel rose from its bed, but I trusted in the use of heavy anchors to keep them apart, a power which proved to be utterly insignificant. Much to my amazement, as the vessels were lifted the docks came together so firmly that all the means I had at my command were insufficient to start them an inch apart, although I brought into requisition steam craft, gun-boats, etc., whose united action amounted in the aggregate to 1,000 horse-power.

Here was a grave difficulty, and, in addition thereto, doubts arose as to whether I could control enough lifting power to compass the end in view. I might raise a vessel until the broken masts and top hamper touched the caisson's bottom, but could hardly hope to bring her to the surface, and at this time I was working with the lighter vessels. To meet this trouble, therefore, I determined, while altering the docks in use to meet the demand, to construct two others having a lifting capacity equal to the four smaller ones, and for this purpose had to penetrate some hundreds of miles into the country to cut the requisite timber. Suspending all raising operations until the new docks were completed, I took the field with the six, and if you will kindly follow me, I will explain, in some detail, their construction, taking one of the larger ones for illustration.

The outside shell of the docks was built of plank in timber frames, zinced on bottom and sides for a distance of three feet, and divided into six water-tight compartments, in the center of which was the well or pump chamber. This framework was braced with trussed or open girders in such a manner as to give the whole structure the greatest strength and rigidity consistent with maintaining the necessary buoyancy and distributing the strain, when engaged in lifting, over the whole area of the docks. The cast-iron wheels over which the lifting chains passed were also braced and supported by two iron bars, and each dock was provided with an engine of forty-horse power to work the powerful centrifugal pump in the pump chamber, as also the winch above, to which the falls were taken, together with the valves for the admission of water, which were worked by means of spindles reaching to the deck and opened or shut by a key winch. Between each compartment were sluice-valves, allowing the water to flow equally into such of the compartments as might be necessary, and a pipe led from the pump through the side of the center compartment for the expulsion of water, while another connected the pump with the hose used, as hereafter referred to, for pumping out the vessel when raised.

In raising weights of less than 1,000 tons, I rarely needed to submerge the docks, but admitting water into the after compartments to act as a counterpoise. I could with ease run such burdens to the surface by means of the five part fall, hooked on the lifting chain and taken to the steam winch. The majority of the vessels, however, which I raised, being of far greater weight, the process I adopted for them was as follows, by which mode I had a lifting capacity of over 5,000 tons:

Presupposing that the docks or caissons were moored in proper positions directly above the sunken vessels, and the lifting chains passed beneath the bottom, the valves and sluice-valves were opened and water freely admitted into all compartments until the docks were submerged to within a few inches of the surface of the water. All valves were then closed, the chains hauled taut by the falls, and water being retained, as before, in the after-compartments, that in the fore-compartments was expelled by pumping, the vessel was correspondingly raised, taken in tow, together with the docks, to shoal water until she grounded, when the operation was repeated until the deck came above the surface; all leakages were then roughly stopped, and the hose leading from the pipes passed into the vessel and the pumps set to work, until she floated and allowed me to clean out the accumulated mud, rubbish and ballast.

It is evident that if at any time during the operation an uneven strain on either of the chains occurred, the dock would immediately cant, giving an opportunity of re-adjustment before such chain could part. With the chains lay the chief difficulty; the ordinary chain cable of familiar form was, as I knew from former experience, of no avail, when subjected to a heavy strain, invariably drawing out and crushing the stud; and when I began operations, it was with a chain consisting of solid iron links, each two feet in length, and pinned together in a manner not unlike the chain which passes around the drum of a watch. This chain was manufactured of best American iron, two inches thick by four inches in width, and connected by a three inch steel pin. With it I was partially successful; but after parting it like pack-thread more than a hundred times, I concluded it would be imperative to procure some other chain capable of resisting the heaviest strain which I could expect to meet.

I accordingly designed a chain, probably the heaviest in use up to that time, and whose links were constructed with only a sixteenth of an inch play in either side, the sides being parallel. I was, of course, obliged to send to England for this to be made, and I forwarded the design through my agent to Messrs. Brown, Lenox & Co., with instructions to manufacture it of Low Moor iron. They telegraphed back that the form of chain was bad, and that it ought not to be made of Low Moor iron. Deeming myself the best judge, from mature experience, on both these points, I could only reiterate my directions, and at last received the chain as ordered. It answered the design completely, never parting in a solitary instance, and the form, I believe, is now in use to some considerable extent, its efficiency and reliability having been amply proven.

And now to refer to what doubtless is a matter of some curiosity on the part of every one here, and which was to me, let me assure you, the hardest problem encountered, namely, the slinging of the vessels. I had secured enormous lifting power, but for a time it bid fair to be utterly useless through the inability to attach it to the weight designed to be raised. I tried every method of slinging without success; and it is only those who have had practical experience with the subject who can form an adequate idea of the difficulty of placing ponderous chains of the character named.

It has been my lot, more than once, in conversation with gentlemen interested in the question and owning inventions of more or less merit, to hear them say, "I should pass this chain here or there," as if they were speaking of a watch chain. Why, when we consider that each link of such a chain-cable as must be worked in these operations weighs more than a hundred weight, the "passing" referred to is a process that I venture to say, among theoretical projectors, has in no instance received the attention it demands, but is too often taken for granted; and such gentlemen start off on their theory with the vessel already slung, when that is the point at which they should commence and which must first be overcome. This reminds me that possibly I should have explained my method of slinging in an earlier part of this lecture, but again I have to ask your indulgence, for reasons before stated. Upon every attempt to sling, either by sweeping or girding the vessel to be raised, the chain parted or slipped; when I led the chains through the ports, they cut up everything. I then had recourse to the following expedient upon a sixty-gun frigate:

With the impediments necessarily attending such work, conducted at a depth of some sixty feet below the surface of the water, I contrived to cut four holes through either side of the vessel below the orlop deck, about sixteen inches in diameter, and after crowning the same with one-inch boiler plate, passed the lifting chain through the aperture, hauled taught, and attempted to weigh the vessel; with irresistible force the chains cut up through everything, and thus another failure was registered.

I now became convinced that the sole method which would answer was bottom slinging; and turning my mind in that direction, I accomplished my design by the very simple means of placing chains of the size above described beneath the keel of every vessel, with dispatch and satisfaction.

I had a flat iron scraper, about two feet in width and eighteen inches in depth, constructed of quarter-inch plate iron, to which a strong iron handle was riveted. To this handle was made fast a rope, carried to the capstan in a vessel moored alongside the docks, and a diver having conveyed it down and adjusted it against the side of the ship at a point where the chains were required to be placed, the scraper was drawn from above through the mud, readjusted and redrawn, until a channel had been made along the vessel's side to within a short distance of the keel. The diver then made use of a long curved flat-pointed iron rod, having an eye in the head through which was passed an inch rope. This he pushed under the vessel's keel, and it was drawn through from the other side by the diver occupying the corresponding channel. In this manner a way was opened for the introduction of small chains, and ultimately of the heavy lifting chains themselves, which were hauled through from above and attached to the dock. Thus, what threatened to prove an insurmountable obstacle was happily overcome, and from that time on I met with no worse difficulty than occasional bad weather.

It must be remembered that the whole of the operations were conducted in an open harbor, with no tideway, and exposed to the unbroken action of the winds and waves. Here, however, is shown a marked feature in the system: the docks, when in use in heavy weather, had only to be submerged where moored, and they outrode any gale or tempest, and during the whole time of the work not a single accident ever befel one of them. With equal facility they were propelled even in fresh water, and it was only during the very heavy blows that operations were at all suspended.

A few remarks upon the undertaking generally may not be uninteresting. Immediately after the battle of the Alma, the first line of vessels was sunk, all standing, between forts Constantine and Alexander. The terrific gale that subsequently occurred, when so many transport vessels were lost and damaged, cleared away all those parts of the masts and rigging which had previously risen above the surface of the sea. These vessels had been sunk with all their guns, but in only one instance was this afterward done.

The authorities, after sinking the first line of vessels, had the batteries of the remainder of the fleet removed, replacing them with large blocks of stone of equal weight, the guns so removed going toward the equipment of the fortifications on the land side.

On preliminary investigation of the sunken fleet, it was seen that the teredo, a minute but destructive mollusk, had made fearful ravages in the upper works of the wooden vessels, that portion of the timber only escaping which had been covered or coated with mud. The extent to which this pest of those waters had completely honey-combed every inch but what had been protected, would have appeared to me almost incredible, had I not been an eye-witness of it. Specimens of timber containing the teredo were forwarded by me to the Russian government, and I believe are now shown in the museum at St. Petersburg, and in other cabinets throughout Russia.

During my stay at Sevastopol, two blocks of wood were sent to me to test, one coated with a composition which it was asserted would defy even the teredo's attack; but after four months' submersion, I found each equally perforated. The maker of the composition in England troubled himself to write me several letters on the subject, urging me to state to government the result of the test. Finding he would not be otherwise satisfied, I was compelled to make what could not be otherwise than an unfavorable report of his preparation.

With the iron vessels I was particularly fortunate. In the case of the war steamer "Elborross," which was docked, even the paint was in order, save where the chains had chafed, and that vessel was subsequently in commission as the yacht of her imperial majesty the Empress of Russia. I may here be permitted to mention that for this labor of raising and removing intact more than seventy ships of war in the harbor of Sevastopol, I received the public thanks of the Emperor of Russia, who remarked that I had introduced a system and performed a species of engineering which had no parallel; and I was also knighted by Russia, France, Italy and Turkey.

I would now request your attention for a few moments to the chief end I have in view in this lecture, namely, a short and concise demonstration of the fact that my system of ship raising can be applied with great facility and advantage to the lifting and floating of vessels of all descriptions over sand banks and bars at the mouths of rivers and entrances to harbors and ports.

The accumulation of sand and mud in these localities may rightly be ascribed to a diversity of causes, prominent among which may be mentioned two in particular—the winds and currents. They collect and pack together any loose debris they may find, and just so long as these overwhelming forces are destined to act, will the process of filling up and obstructing continue, and the vital necessity exist for clearing away such deposits, in order to keep open a channel wide and deep enough to admit of the ingress and egress of freighted ships; or else, as is now the practice in many places, the freight will have to be conveyed beyond the bar by means of lighters to meet the ship whose draught excludes it from the harbor within; both of which resources are far more elaborate and uncertain than the very simple, safe and economical method of buoying up vessels, the efficacy and facility of which I have made known to you this evening.

Dredging has hitherto been resorted to, and resolutely carried forward, and is to-day practiced in various parts of the world to a very considerable extent, but in most cases without permanent utility. I might cite the instance of the mouth of the Danube, where, perhaps, the most extensive system of dredging known has been pushed on with praiseworthy vigor from time to time for the past quarter of a century. But I need not look so far away; for dredging, as a means of clearing a channel, has been abandoned, as utterly hopeless and worthless and a waste of time and labor, at the passes of the Mississippi; and numerous instances might be named of failure in the prosecution of this useless work along our sea-board. It may afford a momentary relief in some cases, and a slight increase of water might be obtained; but just as soon as the dreging is discontinued the sand and debris are again deposited.

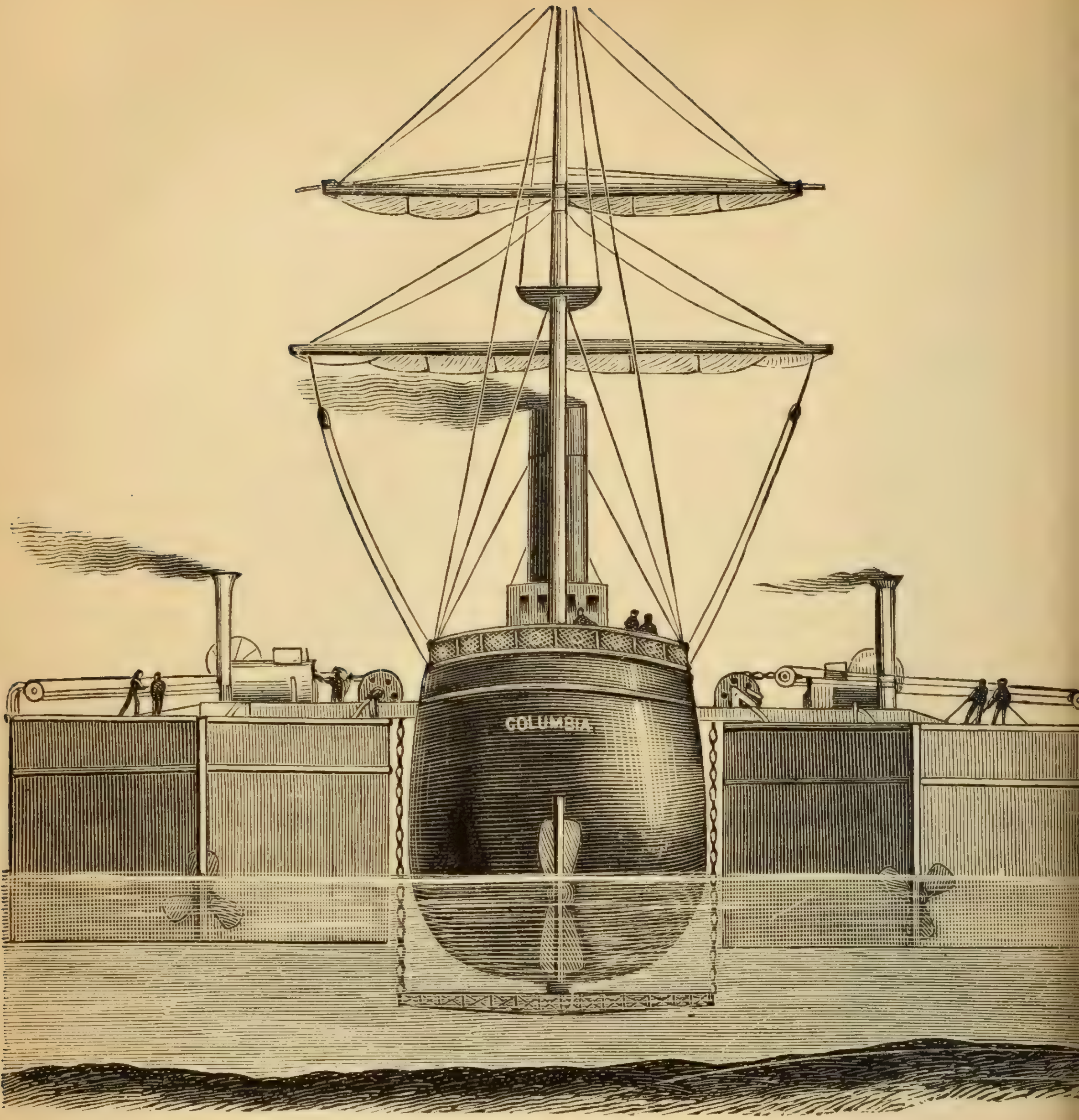
Dredging a bar is not unlike dipping water out of the ocean; the space cleared immediately closes up just as soon as the work is suspended.

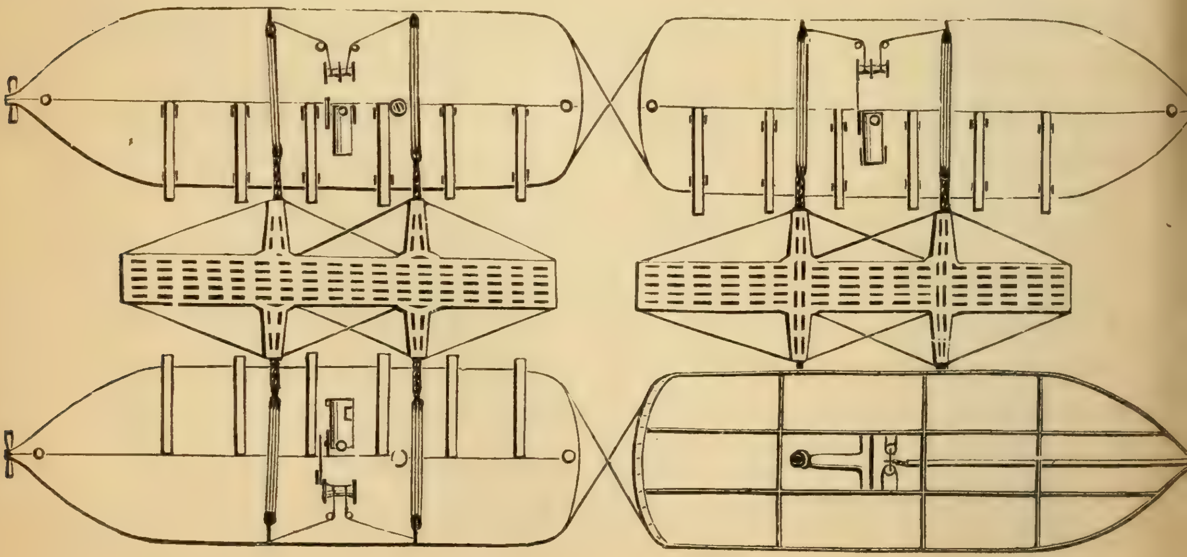
I am guilty of no fiction in saying that many millions of dollars have been literally sunk in the sea, in futile efforts to dredge out bars at the entrance to commercial ports. At the approach to the magnificent bay of New York, a port of entry unsurpassed in the world, and which has been said to rival, in picturesqueness and beauty, the far-famed bay of Naples, exists an obstruction which effectually prevents the passage of vessels drawing more than twenty-two or twenty-three feet at average high tides, and which defies the best skill of engineers to remove or keep in check. The steamer "Italy" very recently was delayed outside of the Narrows for several hours, until she could run in on top of the tide, she being of tolerably heavy draught; and the same company to which she belongs are now engaged in constructing still another fine vessel to draw a couple of feet more than the "Italy," and which will be effectually barred without the intervention of any statute of limitations. At one time I myself was conveyed in a tug-boat, with a number of fellow passengers, from the piers at this city to a point beyond Sandy Hook, in order to embark in the Inman steamer "City of Paris," which was compelled to precede her passengers, so as to pass over the bar while the tide was sufficiently high to admit of her so doing. Nor is this an isolated instance of such a delay, for I have heard that similar inconveniences are of almost weekly occurrence. Philadelphia, Charleston, Savannah, Mobile, New Orleans and Galveston are each of them fine ports, but similarly closed to commerce, and to a far greater extent. Philadelphia, as you know, stands on a peninsula between the Delaware and Schuylkill rivers. Its harbor is at the head of the ship navigation of Delaware bay, a vast arm of the sea. But with all their natural advantages, it is only at the full tide that sea-going ships are able to pass the harbor and river obstructions; and in most cases they are obliged to await repeated tides, in order to proceed up as far as the city. At the mouth of the Mississippi the difficulties are of the most formidable character, and such as to preclude the passage of vessels of ordinary tonnage.

The port of New Orleans is bound up by a bar with but seventeen feet of water, despite all the efforts which have been made to dredge out and deepen the channel.

I need refer at no greater length to the stoppages which lie all along our coast and block up our ports. You know of them as well as I do, and of the struggle to overcome them. We fully realize the importance of the evil, and the simple question comes up, "What must be done?" I think I can tell you. What is required is a method by which vessels of the largest class can enter port with their freight, unload, take in cargo, and again depart free from all danger of detention. And this, gentlemen, I do not hesitate to assert upon my professional judgment, *can be done.*

In a few words I will describe to you a positive remedy; a system by which vessels of the heaviest tonnage may be safely and quickly *borne over* a bar, and that too at a comparatively moderate outlay. The system which I advocate is no chimera, but a thorough, practical and well-timed means, often tested by me at Sevastopol harbor, and I am convinced, by the experience I have faintly endeavored to shadow forth to you to-night, that no better process is extant; for with it a certainty has been achieved and an end accomplished; and I may be pardoned for the foregoing confident assertion, when you reflect that previously no perfect success, under equal difficulties, had ever resulted from operations for raising sunken vessels, while almost fabulous sums have been expended in futile and disappointing attempts. And I have deferred it until now to state, that every vessel which I


COLUMBIA



raised at Sevastopol I triumphantly carried a distance of more than *five miles, while suspended to the floating docks*; and this without straining a single timber, as they hung as securely in the supports, and were borne along as gently, as if resting on the buoyant bosom of their native element.

At this stage of our lecture perhaps I had best describe to you as well I may, the way in which I propose to float vessels into port, the machinery I shall make use of, and its mode of application. The machine which I propose to use, and of which I have had full and exact drawings made, will consist of four floating docks, built wood or iron; each dock about 160 feet long and fifty feet in breadth. They are pointed at the bow and blunt at the stern, like a row-boat, and have a depth of twenty-five feet, each dock being divided into nine compartments, into which the water is admitted by means of valves in the bottom, and the sides of the compartments are also provided with other valves, whereby the water can be allowed to flow from one compartment to another. When it is required to submerge the dock, the valves in the bottom are opened and the compartments fill with water, which is expelled when required by the action of a centrifugal pump connected with each compartment by sluice valves. Each dock is provided with a steam-engine of fifty horse power, which serves the purpose of propulsion and also works the pump and chains. All the bottom valves are opened and closed by suitable rods or levers extending to the surface of the deck, and by means of sluice-valves the communication between each or all of the compartments and the pump-chamber is opened or closed at pleasure, and the water can thereby be confined to the after compartments, to balance the weight of the vessel to be lifted, or allowed to flow equally all through the dock. The pump-chamber or central compartment must be made water-tight, but the other compartments need not be so constructed.

Now picture to yourselves two of the floating docks standing stern to stern and held together by strong cables, and parallel with them the other two docks, similarly connected at the stern, each pair of docks being far enough apart to admit of the action of the cradles or supports which are to hold the vessel to be buoyed up. The cradles are built of iron, and are simply flat floors 120 feet long and fifteen feet broad. The pulleys over which the main or lifting chains pass are supported so as to turn freely in strong iron brackets, which are firmly secured to the deck of the dock, and are strengthened by diagonal tie-rods, whose lower ends are secured in shoes to the bottom of the girders.

The lifting chains are passed through holes in the brackets, and are held fast by clamps bolted to one of the links behind the brackets. These chains are attached to strong running-blocks or sheaves which are connected with the ropes or chains; the latter are passed over suitable guide-pullies and through the fixed blocks to the barrel of the winding machinery arranged in the center of the dock. Two cradles are used in the process of lifting, which lie in a horizontal plane, end to end, one being slung from each parallel pair of docks, and both being employed to sustain the weight of the vessel.

Why, gentlemen, I am sure, (and I know of what I speak), that I could lift and bear the "Great Eastern" the largest steamer afloat, over the bar at Sandy Hook and carry her out again, without straining a single plate or screw during the process; and no better test than that can be imagined or will be likely to occur. One of the vessels which I raised in Sevastopol harbor weighed upward of 5,000 tons, and in addition was filled with mud and *debris*; and to do this I was obliged to resort to no greater precautions than I had taken with the others.

My plan, both by its ease and economy, would seem to be the most natural, as well as the most effective and thorough in the work done and manner of performance. It is this simple system which I wish to introduce into general use. I have submitted my plans to eminent engineers in London, New York, and New Orleans, and they all agree that it is the most practical and feasible method by which ships may be enabled to pass a bar. I purpose constructing docks of a description somewhat analogous to those which I used at Sevastopol, but with the addition of a heavy trussed cradle for the vessel to rest upon In conversation with the president of one of the largest line of steamers which ply across the Atlantic, he remarked that it was soon their design to commence running a new line to St. Thomas and Aspinwall "and," said he, "Colonel Gowan, if you will apply your system to the bar of Galveston, we will also run them there." The Chamber of Commerce at New Orleans, to which I submitted my plan early in April of this year, also reported in the most favorable and encouraging terms in behalf of the introduction of my system for lightering vessels over the bars at the choked-up mouths of the Mississippi, and the following resolutions were unanimously passed by the Chamber, after I had described to them at some length my mode of operation:

Resolved, That the report of the Committee on Obstructions be adopted, and that the system of Colonel John E. Gowan for opening the mouths of the Mississippi to the largest class of vessels, is recommended to the favorable consideration of the State and National governments.

Resolved, That the thanks of the Chamber of Commerce be tendered to Colonel Gowan for his able and interesting lecture; also, that the report of the Committee on Obstructions be published, and that a copy of the same be forwarded to each of our Senators and Representatives in Congress, as well as to all Senators and Representatives, also, Governors of States bordering upon the Mississippi river.

(Signed), GEORGE A. FOSDICK,
Chairman of Chamber of Commerce.

The *New Orleans Picayune* also published an ample article upon the same subject, from which we quote the following paragraphs:

"A score of plans for obtaining this most desirable end has been proposed, and the most ingenious theories have been published on the subject, each of them claimed, by its inventor or advocate, to be the best and the only one calculated to secure a remedy. We have had propositions to dredge the bars by means of machinery peculiarly constructed for that particular purpose; others to confine the current, by a system of jetties, to a narrow limit, so that its increased strength would sweep away before it the deposit of earthy matters held in suspension by the water, and precipitated to the bottom at the point where the water meets the inflowing tide from the sea. The dredging system, even were it capable of making a channel of sufficient depth of water to secure the passage of vessels of large enough tonnage to make their employment in voyages to this port profitable to their owners, has against it the serious objection that the depth of water secured by it is not permanent, but demands unceasing labor and application of the means employed, as the alluvial deposits are continually renewed, and must therefore be continually removed; and it is extremely costly.

"We incline strongly to the conviction that what is so much desired can be accomplished by the adoption of a system of floating heavy draft vessels over the bars, and that the invention of Colonel John E Gowan is better calculated to do that work than any other yet brought to notice. This gentleman has devoted more than twenty years to the business of raising sunken vessels, and has met with remarkable success in it.

"We will not attempt more than a very brief description of his process, which consists of a number of caissons, divided into water-tight compartments, which may be filled or emptied as occasion requires, and are furnished with ample steam-power for the filling or exhaustion of the compartments, and for locomotion, as well as for working of the machinery for raising the vessel to be carried over the bar to a proper hight.

"The principle is in some respect not unlike that of the dry-dock, the caissons being first brought into proper position with regard to the vessel, which is to be raised enough to carry her over the obstruction, and then filled with water, so as to sink them to the required level, after which a strong girder is passed beneath the vessel, to which are attached chains of great strength, by means of which and the simultaneous pumping out of the water from the caissons, sufficient buoyancy is obtained to float the vessel over the obstruction. The process, it will be seen, is quite simple. That it is no mere theoretical proposition is fully demonstrated by its successful application by the inventor in raising the sunken Russian war vessels in the harbor of Sevastapol. One of those vessels weighed five thousand tons, and was filled with mud. A committee of the Lloyd's Salvage Association, consisting of distinguished officers of the British navy, after careful examination, approved of it, and Sir Charles A. Hartley, chief engineer of the commission for regulating the mouths of the Danube, bears testimony to its value and merit.

"We are informed, also, that Gen. Beauregard, who, besides his admitted competency as an engineer, has paid great attention to the question of the bars at the mouth of the river, speaks of Col. Gowan's plan in the most favorable terms.

"The inventor declares that by using his process he could bring the Great Eastern over the bar and carry her out again. We trust that our business men will take this matter promptly in hand, with a view to secure its manifest advantages in aid of our commerce."

The objection may be raised, that if dredging and channeling were to be entirely suspended, accumulations might continue to increase until the inlet to harbors would be altogether stopped up. But a moment's reflection will show that this could never be, on account of the constant working of natural laws. The river must find an outlet large enough to permit it to empty itself into the sea. Spring freshets with augmented force would contribute to sweep away a portion of the winters debris, and the ebb and flow of the tides must exert a continuous influence unfavorable to the complete closing up of a channel. Indeed, experience proves that sand-bars remain of nearly the same proportions during long consecutive periods; and if by any remarkable combination of circumstances the mouth of a river should become entirely blocked up, the stream would soon furrow for itself a new and sufficient passage with increased and irresistible impulse. During the late exhaustive war in this country all dredging operations at the mouth of the Mississippi were suspended *in toto*, and for the period of four or five years the income in the deposit at the bars was quite imperceptible or infinitesimal. On the contrary, if the natural accretion is disturbed, but a correspondingly short interval elapses before the mighty influences of tide and wind and elements combine to bring back the lost debris and restore it to its former place. What is wanted, therefore, is a principle such as that I speak of, which acts and does its work with independence and uniform regularity.

When in May, 1868, I laid my plan before the Lloyd's Salvage Association at London, it was referred to a committee of its officers, consisting of Post-Captains Russell, Curme, Hurne and Bonham, of the Royal navy, who reviewed it and reported most favorably, and their indorsement was virtually that of the British Admiralty.

A little earlier, Sir Charles A. Hartley, engineer-in-chief of the Danubian commission, for regulating the mouths of the Danube, which was created by the Treaty of Paris at the close of the Crimean war in 1856, wrote me a note, which I beg leave to read:

"London, *January* 16, 1868.

"Dear Sir.—I have examined the drawing you have exhibited for raising sunken ships, and the system appears to me to be a very simple and practical method for accomplishing that object. I assume that the caissons you propose constructing are of the same description as those you used so successfully in raising the men-of-war sunk in the harbor of Sevastopol during the Crimean war.

"Your well known success in raising the Russian fleet, together with my own views regarding the practicability of your invention, enables me to bear a willing testimony to its value and merit.

"I am, dear Sir,
"Yours very truly,
"Charles A. Hartley."

"Col. Gowan."

Here, just in passing, let me direct your attention to a consideration of the immense foreign traffic in breadstuffs which could, and doubtless will be carried on when our harbors are thrown open to large draught vessels.

With Europe disturbed, as at this time, by exhaustive wars, and the producing classes of the people under arms and unable to till the soil, America might become, with every degree of probability, the grain mart of the countries of the Continent. This, gentlemen, is a matter of great importance. It cost the price of two bushels of corn in freight to bring one bushel of corn from the west by rail to the city of New York; that is, *two bushels in every three are consumed in transportation;* whereas, if floated down the Mississippi, and thence across the ocean, to which there is no natural impediment except the shoal water at the mouths of that vast estuary, breadstuffs could be sold in France and England as cheaply as, and of a better quality than, those imported into those countries from other scources. The chief supply of breadstuffs for the European market is now derived from the broad fields of Russia. $100,000,000 worth of grain from that empire is annually consumed in Great Britain and France alone. What a magnificent market is that for the employment of American enterprise and industry! With the port of New Orleans accessible to first-class vessels, say of five or six thousand tons burden, the native products of our western States would be shipped abroad at a figure defying the competition of the world, and an impulse given to the agricultural interests of this country, which would make us the grain-growers, *par excellence*, of all christendom.

I have spoken more particularly of New Orleans in connection with the exportation of western breadstuffs to Europe for the sole reason that the great natural artery of our continent, the Mississippi, passes out at that port of shipment, and thus offers the easiest and cheapest route to the Atlantic. But the discouraging fact stares us in the face that ships of sufficient burden to bear our breadstuffs to a ready market, at low prices, cannot get over the sand-bars which block up the port. It costs less to employ vessels measuring five or six thousand tons in a carrying trade across the ocean than it does to make shipments in vessels of six or seven hundred tons. Any shipping merchant will answer for the accuracy of this statement. And again, the distance between New Orleans and Great Britain is no greater than between southern Russia and Great Britain.

During a conversation I recently had with the able and far sighted president of the Central Illinois railroad, said he "If the harbor at New Orleans can be opened up I see no reason why the grand granary of the west should not empty itself, in an unbroken flow, into the lap of Europe. We have the corn, we have the great canal, but we cannot freight the ships at New Orleans, but have to send by rail to open ports, where corn can be shipped at the wharf."

Hitherto, gentlemen, our crops of corn, wheat and rye have rotted in the ground because the supply exceeded the demand in this country; and it is only in times of destructive and engrossing wars in Europe, of drought or famine, that we have succeeded in sending our products there at remunerative rates. We have not been able to compete with far-off Russia in this trade. But sweep away the bars which hedge in our bays and our harbors and the great grain fields of the western States will be as accessible to Great Britian and France and Germany as are those broad acres rich with waving spears, less harmful than the spears of Dons and Cossacks, which lie beyond the frozen seas of the Muscovite dominion.

The importance of this matter I need not further urge upon you. A great evil exists, a great want is felt, a wide field is spread out before you by the hand of Providence, teeming with opportunities. Our ports are virtually blockaded by natural difficulties, which will never be cured and may hardly be alleviated, by the most expert engineering skill and knowledge that can be brought to bear. National industry and enterprise will be newly awakened if an expedient can be found which will afford a remedy, cardinal and adequate. It is no presumption in me to claim that the solution of this serious problem is embraced in the system I have made known to you, a system simple as it is sound, and well tried and tested, and proven to be founded upon the rock of correct principle. The truth is before you and, I doubt not, the conclusion which you will arrive at will be fully in confirmation of my own, that ship-raising and carrying across harbor obstructions will become one of the future and fixed facts of this great century of discoveries, improvements and scientific advancement.

Professor Whitney considered the paper read by Colonel Gowan one of the most valuable to which this society had ever listened. It had shown the triumph of American engineering on the shores of the Black sea, and it showed how the obstructions to navigation could be partially and perhaps wholly obviated. It pointed out great changes in the future, and opened the way for breadstuffs of the western prairies to reach Europe without obstruction, the result of which would be to cheapen bread in every part of Europe, and the artizan in the remotest regions of civilization, would have reason to rejoice at the triumph of American engineering. He concluded by moving a vote of thanks to Colonel Gowan for his lecture.

The motion was unanimously agreed to.

Mr. T. D. Stetson inquired how far the docks and caissons at Sebastopol were sunk at the time of storms?

Colonel Gowan.—They were sunk to the water's edge. This relieved them from the force of the wind.

Mr. Stetson.—Are there heavy waves there?

Colonel Gowan.—The heaviest I have seen, and I have been in all parts of the world. These vessels were in the roadstead, outside of the harbor.

Mr. Stetson—I remember hearing, some years ago, about a scheme at Nantucket for lifting vessels over the bars. I have not heard of it lately.

Colonel Gowan.—That was constantly used until the shipping interest fell off there. It was used as long as they had whaleships. They had camels, which were put under the water and then pumped out. They have taken vessels over the bar at Nantucket in this way, I think, for thirty or forty years. The same thing has been done, to some extent, in Holland and in France, quite a number of years ago.

The Chairman.—The only patent taken out by President Lincoln, and that many years before he became famous, was for getting flatboats over sand-bars in a river.

Professor Whitney.—That invention consisted of a flatboat having overhanging guards, beneath which were expansible chambers, opening like an accordeon. In going over a bar these were opened, and when the boat passed over they closed up under the guards. It was a very ingenious invention, but how useful I am not prepared to say.

Mr Fisher.—As to the intimation in the lecture, that there is a limit to the filling up of a river, I remember that the river Po is about fifteen feet above the surface of the country. Bringing down silt from the mountains, it would have overflowed the country but for the embankments.

Colonel Gowan.—That would involve the necessity of levees on the sides of rivers, because there is no dredging carried on except at the bars.

Mr. Fisher.—Our coast survey has shown that at Sandy Hook, and at the bars at the entrance of New York harbor, the depth of water is diminishing. Those bars have been steadily increasing ever since the surveys began.

Colonel Gowan.—During our late war no dredging took place in the Mississippi, but the bars did not materially increase.

Mr. Fisher.—I suppose that for so short a time the increase is not sensible, but it goes on steadily.

Colonel Gowan.—You must remember that millions of tons are annually carried down the Mississippi.

Mr. Stetson.—There are four tons per second delivered at the mouth of the river.

Dr. J. V. C. Smith.—I wish to express my admiration of the lecture to which I have been listening. I am proud of it, because it is a practical illustration of what has been accomplished by an American. I wish to call attention to the opinions of eminent geologists with regard to the accumulation of bars and their functions. Rivers are the arteries and veins of the world. It is the great function of rivers to level the mountains, and to transport the matter above water into the ocean. I have recently passed over the Sierra Nevada and Rocky mountains, and seen the beds of great rivers which have long since accomplished their work; but there was no water there. The river was gone. The bars at the mouths of rivers are placed there to prevent the water from running too rapidly away from the country. If it were possible to remove the obstructions from the Mississippi river, the water would run so rapidly that the country would lose the benefit of the evaporation; and not only would the grasses and hay crops suffer, but animals themselves would suffer for the want of water. At the mouth of every great river there is a bay. That is a permanent law. At the mouth of the Nile I passed over a canal forty miles in length to get above the bar. Since the time of Herodotus, 2,300 years ago, the bed of the Nile has risen seventeen feet. It is stated by Sir Charles Lyell, that the delta at the mouth of the Mississippi river extends 300 miles out into the Gulf of Mexico, and a thousand or two thousand years hence that great extent of country will be habitable, as the land in the neighborhood of New Orleans is now inhabited. But if that natural barrier was swept away, the water would rush down to the ocean and drain the country, and it will become unhabitable. Therefore we must have bars; they belong to the constitution of the globe. Instead of spending money in removing them, it is far better to avail ourselves of the simple process stated this evening, to raise our vessels over them. Wherever this apparatus is constructed it will enrich the country, whether at New Orleans, Boston, or New York. Wherever facility is increased for commerce we shall have greater activity of commerce, and human industry will be encouraged. We shall open the way to the sale of our breadstuffs, all over the wide world if we sustain the proposition that is made to us in the lecture of this evening.

Adjourned.

December 15, 1870.

Prof. S. D. TILLMAN in the chair; ROBERT WEIR, Esq., Secretary.

The chairman announced the programme of the course of scientific lectures for the winter.

Mr. R. G. Hatfield exhibited and explained a model of axle-bearings requiring no oil, the bearings rolling upon their supports, as in the roller sheave, and on the same principle on which the domes of observatories are constructed. It is intended for a reciprocating motion, as in elevators. The axle rests upon two straight iron bars, which traverse under it, resting in their turn each upon two rollers which follow the course of the bars, rolling upon a horizontal support. The invention arose from the necessity of an invalid lady for an elevator by which she could be carried up and down stairs. When properly balanced she could, without assistance, by exerting a power of three to five pounds, rise to the second story, or descend to the first.

The Chairman stated that the same principle had been applied in moving the great rock which sustains the statute of Peter the Great at St. Petersburg. It was transported over the ice in winter, being rolled upon cannon balls, over iron plates laid on the ice.

Mr. Fisher.—That block of stone weighed about 1,100 tons, and, I think, came from Finland.

Mr. Hatfield also explained a modification of this invention, adapted to continuous motion. The straight bar is transformed into a ring resting upon a series of rollers. The circular bed upon which these rollers revolve is depressed slightly in the center, so that the ring shall always rest upon two rollers, and be free from tendency to undulating motion.

Mr. Fisher expressed a doubt whether the friction was reduced sufficiently to compensate for the expense of the apparatus.

Mr. Blanchard suggested that the difference in friction could be readily perceived by turning the wheel until the axle reaches the stop at the end of the bar. The rolling then ceases, and the friction of an arbor begins, if the wheel is still turned.

ON TRANSMITTING POWER BY MEANS OF COMPRESSED AIR.

The Chairman, Dr. Tillman, introduced the subject with the following remarks: Dr. Dennis Papin, the eminent French engineer, who invented the atmospheric steam-condensing engine, was among the first, if he was not the very first, to attempt the transmission of power through the medium of compressed air. He proposed to use the power of a steam engine, situated above ground, in carrying compressed air into coal mines, where it was to be employed in working pumps for draining such mines. His plan did not succeed, and its failure must be ascribed to defective apparatus, for a method essentially the same has since been used at coal mines, the power being applied to apparatus for cutting out coal. Nearly a hundred years after Papin's attempt, a machine was erected in Wales, at a waterfall which, by means of water, worked a series of cylinder bellows for compressing air to be used as a blast at an iron foundery situated about a mile and a half from the machine. Great care was taken to make the conducting pipe air-tight, and smooth as possible on the inside. On setting the machine in operation, it was found that more than ten minutes elapsed before any movement of the air was perceptible at the furnace, and this was hardly strong enough to extinguish a lighted candle. This failure was also ascribed to defective apparatus. No further attempt was made to use the machine, and there seems to have been a general acquiescence of engineers in the opinion that power could not be conveyed through long pipes. Had the plan been pursued of closing the further extremity of the pipe until the air had become fully condensed to the point of pressure required, and then using the power of the compressed air only so fast as power was generated by the compressors, there would, doubtless, have been a very different result, and an early path would have been opened to that success which has been achieved by engineers of our own time.

The first successful use of power transmitted by compressed air was at the Mount Cenis tunnel, in 1861. The plan was devised in 1857, by Messrs. Sommeiller, Grandis and Grattoni, and put in operation at Mount Cenis, in the superintendence of the first named engineer. The air-compressors were of two kinds, one a pump placed horizontally and surrounded by water, for the purpose of absorbing the heat generated in the compression of the air; water and air filled opposite portions of the cylinder, and the power of the water acting alternately on each side of the piston compressed the air and discharged it into a receiver. The other was on the principle of the hydraulic ram; a column of water eighty-five and one-half feet high was allowed to enter at the bottom of a chamber fourteen feet high and two feet in diameter, containing air, which, after being compressed, was discharged from the top into a receiver; when the air and water tubes were again filled, the water was brought under the air column and the process of compression was repeated. The compressed air was carried from the surface of the mountain to the interior of the tunnel by means of an iron pipe, having an internal diameter of seven and five-eighths inches; it had a tension of five atmospheres above atmospheric pressure. By this means an effective pressure of 216 pounds was brought on the piston of the machine, which gave 250 blows per minute on the drills or borers.

The success of this plan of tunneling rock has warranted the use of an improved apparatus at the Hoosac tunnel, in the State of Massachusetts. At one end of this work, the air is compressed by means of water power derived from Deerfield river, and at the other by a steam engine. The compressed air is carried from an iron pipe through an India rubber tube against a piston, the rod of which is directly attached to a rock drill. This portable borer is the invention of Dr. Burleigh, and has been found both convenient and effective. With regard to difference between the power used to compress the air, and that expended in useful work on the boring apparatus, I have seen no estimates from engineers having such works in charge, but as the subject has been ably treated by Dr. F. A. P. Barnard, president of Columbia College, I propose to quote from the celebrated report of that distinguished physicist made to Congress, "On Machinery and Processes of the Industrial Arts, and Apparatus of the Exact Sciences" in the Paris Universal Exposition of 1867, page 136.

TRANSMISSION OF FORCE BY MEANS OF AIR HIGHLY COMPRESSED.

"But though the particular mode here proposed of employing compressed air as a means of transmitting force may not seem to recommend itself on the score of economy, it does not follow that the other method, viz.: That in which the compressed air is made to act directly by its elasticity, may not be more eligible. This question deserves examination, because if compressed air in tubes will serve economically as a medium of transmitting power, there will be a sensible advantage in employing it instead of the telo-dynamic cables of Mr. Hirn, of which the exposure for great distances above ground, and the many moving parts, constitute so many liabilities to derangement or injury.

The engineers of the Mount Cenis tunnel have expressed themselves strongly in favor of the view that the plan is truly economical, and as their experience in the use of this form of applying power has been larger than any which has been elsewhere enjoyed, their statements deserve consideration. At the date of the report on the progress of the work in the tunnel during the year 1863, they were engaged at a distance of nearly two thousand metres from their reservoirs of con densed air, and were driving nine bores with a force of two and a-half horse power each. The tube conveying the air to the perforators was two decimetres (nearly eight inches) in diameter. The air was under a pressure of six atmospheres, and its velocity in the tube was nine decimetres (three feet) per second. The transmission of the power to this distance, and under the conditions, was attended with no sensible loss. The pressure was not perceptibly less at the working extremity of the tube, when all the perforators were in operation, than when the machinery was entirely at rest.

Mention was just made of a series of experiments made at Corsica, in 1857, by order of the Italian government, on the resistance of tubes to the flow of air through them. These experiments were made previously to the commencement of the work upon the tunnel, and while the feasibility of employing compressed air to furnish the motive power of the boring apparatus was considered still questionable. It was the aim of the investigation, not merely to ascertain the absolute loss of force occurring in the transmission of air through tubes of certain particular dimensions, and with certain particular velocities, but to determine, if possible, what are the laws which govern the variations of resistance, when the velocities of flow and the diameters of the tubes are varied. From the results of the experiments were deduced the three conclusions following, viz:

1. The resistance is directly as the length of the tube.
2. It is directly as the square of the velocity of flow.
3. It is inversely as the diameter of the tube.

A table was formed exhibiting the numerical values of the resistances which were actually found to exist under the various conditions introduced into the experiments, these values being referred to the common length of one thousand metres. In the actual working of the machines in the tunnel at Bardonneche, where, as just mentioned, no perceptible loss of power was experienced at a distance of two thousand metres from the reservoirs, the tables would indicate that there should be a real loss measured by a diminution of pressure to the extent of six millimetres of the barometric column, one atmosphere of pressure being represented by 760 millimetres. That is, for a tube two decimetres in diameter and a velocity of one metre per second, the tables give a loss of three millimetres of pressure per thousand metres of distance. But six millimetres is but the one hundred and twenty-seventh part of an atmosphere; and as the total pressure amounted to six atmospheres, the loss, as computed from the tables, would amount to only one six hundred and thirty-fifth part of the total power which the air was capable of exerting. That this loss was not perceptible at Bardonneche was owing to the want of delicacy of the manometer, or pressure gauge, which had only been constructed with a view to show differences of one-tenth of an atmosphere.

A loss, however, which at low velocities and at moderate distances is of insignificant importance, becomes sensible, and even serious, when the velocity is considerable, and when the distance is greatly increased. Inasmuch as, according to the record of the laws above cited, the resistance varies as the square of the velocity, for a velocity of six metres it will be multiplied by thirty-six, while the power will be increased only in the ratio of the volume of air delivered—that is to say, only six times. The *relative resistance*, therefore, or the resistance as represented by a fraction of the power, will be as thirty-six to six—that is to say, will be increased six times. And, in general, it may be stated that while the length and diameter of a tube remain unaltered, and while *absolute* resistance which it opposes to the flow of a current of air through it, varies as the square of the velocity, the *relative* resistance, or the fraction of the power stored up in the current which the resistance consumes, is only as the simple velocity.

In the case before us, the increase of the velocity to six metres per second, supposing it to take place, would increase the absolute resistance to 108 millimetres (thirty-six times three) per 1,000 metres. Experiment finds the value to be 117, which, for the distance supposed of 2,000 metres, would give a total of 234. The absolute resistance would amount, then, to $\frac{234}{760}=\frac{3}{10}$, nearly, of an atmosphere, or $\frac{3}{60}$ of six atmospheres; but the relative resistance would be but the sixth part of this, or $\frac{3}{360}=\frac{1}{120}$ of the total power.

The power of compressed air varies as the product of its pressure and its volume; or, where the pressure is constant, as the volume simply. But the volume delivered varies as the velocity multiplied by the square of the diameter of the tube. As the resistance is inversely as the diameter and the volume directly as the square of the diameter when the velocity is given, it follows that, under a given pressure and velocity, the relative resistance, that is to say, the resistance divided by the power, will vary inversely as the cube of the diameter. We may, therefore, increase the power transmitted, and diminish at the same time the resistances, both absolute and relative, by enlarging the diameter of the tube. There is, no doubt, a practical limit to this expedient; but it would not be to transcend this limit to employ a tube of fifty centimetres, or twenty inches in diameter. The cross-section of such a tube, as compared with the tube of twenty centimetres actually used at Bardonneche, would be $\frac{25}{4}=6\frac{1}{4}$ times larger, and it would discharge, with a velocity of one metre, more than as much air as the latter with a velocity of six. The resistance would also be diminished in proportion to the increase of the diameter; that is, it would be but two-fifths of three millimetres, or a little over one millimetre per thousand metres of distance. This may be considered practically null. It would not amount to a sixth of an atmosphere in 100 kilometres, or sixty miles of distance.

In the supposition just made, we have provided for an increase of power in the ratio of one to six, without any increase of the velocity of the current of air. The same increase might be secured by a smaller enlargement of the tube, accompanied by a moderate acceleration of the movement of the air, and still without a serious increase of resistance. Making the diameter of the tube thirty-five centimetres, a velocity of two metres would suffice to discharge the required volume of air, and the resistance would be eight millimetres per kilometre. With these dimensions and with this velocity, the loss of pressure would be about one quarter of an atmosphere, or one twenty-fourth part of the total pressure, in a distance of twenty-five kilometres, or fifteen miles. Or by making the diamater only thirty centimetres, the velocity required would be 2.7 metres, with a resistance of seventeen millimetres per kilometre, which would amount to a quarter of an atmosphere in eleven kilometres, or six and a half miles.

In the comparisons made above between the loss of pressure in the several cases supposed and the total pressure, account is not taken of the fact that the total pressure cannot be effectively employed in work. It is only the excess of the pressure of the compressed air over that of the atmosphere which can be turned to account. The effective pressure, in the present instance, is therefore but five atmospheres. Comparing with this the losses as computed above, we shall have:

For a power transmitted 100 kilometres by means of compressed air of six atmospheres, moving in a tube of fifty centimetres in diameter, with a velocity of one metre per second, a loss of one-thirtieth, or three per cent of the whole.

For a power transmitted twenty-five kilometres, with air of similar pressure, in a tube of thirty-five centimetres in diameter, and having a velocity of two metres, a loss of one-twentieth, or five per cent of the whole. For a power transmitted eleven kilometres, with air of similar pressure, in a tube of thirty centimetres in diameter, and having a velocity of two and seven-tenths metres, a loss of one-twentieth also, or five per cent. In this case, if the distance be made twenty-five kilometres, the loss will be increased to one-ninth, or eleven per cent of the whole.

These results are favorable; and if all the loss of power attendant on the use of compressed air as a means of transmitting force to points distant from the source were embraced in those arising from the resistance of tubes, they might be said to be conclusive. How far this is true will presently be examined.

Previously to the commencement of operations at Bardonneche, it was confidently predicted by many who doubted the feasibility of the plan adopted, that the leakage would be enormous. This cause alone, it was affirmed, would render the system abortive. It was maintained that the air could not fail to escape through joints the most accurately fitted, and possibly even through the pores of the metal. It is a little surprising, that an apprehension like this last should ever have been expressed, in view of the fact that steam, which is considerably more subtile than air, is habitually confined under greater pressures than that of six atmospheres, without oozing through the walls of the vessels containing it. In regard to the possibilities of leakage at joints, the objection was more plausible, but experience has fully demonstrated its fallacy. No leak has ever been detected, though the tube has been often tested with candle flames throughout its whole length. Nor have the expansions and contractions attendant on changes of temperature due to the successive seasons, affected sensibly the firmness of the junctions. On one occasion, it became necessary to leave the receivers full of compressed air for twenty-four successive days. The loss in all that time did not exceed the five-thousandth part of the daily supply.

The engineers of the tunnel are therefore convinced, not only that the transportation of motive power to great distances by means of compressed air is practicable, but that under certain circumstances it may be largely economical. They give the following hypothetical example in illustration: With a view to avoid introducing into their calculation any element in regard to which experiment and practice have not furnished positive data, they assume for the diameter of the tube thirty centimetres, and for the velocity of the air in it, six metres per second. They suppose then that a water-power is found of sufficient force to maintain in this tube a flow of air at this assumed velocity, under a compression of from six to twelve atmospheres, as may be desired. And they further suppose that this power is to be transported to a distance of twenty kilometres or twelve miles.

A tube of thirty centimetres in diameter will discharge four hundred and twenty-four cubic decimetres of air in one second at the velocity of six metres. Each cubic decimeter of air under the pressure of six atmospheres is assumed by the authors of the report, to represent a power of work measured by one hundred and ten kilograms raised one metre, or, in technical language, one hundred and ten kilogram metres. Hence, the total volume discharged per second will have a force of 46,640 kilogram metres; which, being converted into horse-power, by estimating, as is usual, the horse-power at seventy-five kilogram metres per second, will amount to six hundred and twenty-two horse-power. From this must be deducted the resistance of the tube.

According to the tables deduced from the experiments at Coscia, the resistance of a tube of thirty centimetres diameter to air moving six metres per second, is equivalent to an opposing pressure of seventy-eight barometric millimetres per kilometre of distance. Hence, for twenty kilometers, it will be 1m. 56. and $1.56 \div 0.76 = 2.05$ atmospheres. The air must, therefore, be compressed to eight atmospheres, in order to secure its discharge at twenty kilometres of distance, with a pressure of six atmospheres and a velocity of six metres. In other words, there must be a loss of twenty-five per cent of the original force, and seventy-five per cent will remain available. But suppose that, instead of seventy-five, there be but sixty per cent of the theoretic horse-power realized, there will still remain 373 horse power disposable for use.

The cost of the tube laid down and ready for work is estimated at 800,000 francs=$160,000; being $8,000 per kilometre or $13,000 per mile. This estimate is probably abundantly large, as the tube would weigh only about 100 tons to the kilometre, or 2,000 tons for the entire distance. Two thousand tons, at fifty dollars per ton, would amount to $100,000; leaving $60,000, or nearly $5,000 per mile, for transportation and laying.

The interest on the investment would, at six per cent, amount to $9,600 per annum, which would be equivalent to $25.75 per horse power per annum; and this for a power working night and day. A steam engine, working in like manner constantly, would consume about twenty-one tons of coal per horse power per annum, allowing five pounds per horse power per hour. This is a large allowance; but reducing it to three pounds per hour, or twelve tons per annum, there would still, with coal at five dollars per ton, be a large balance in favor of the economy of the power derived from the compressed air.

The authors of the report further estimate that a larger power, say one of eight or ten thousand horse power, carried to a greater distance, say fifty kilometres or thirty miles, would cost, pro rata, much less; not more, perhaps, than one-half or one-third the amount above computed. Thus it is observed that the cascade of Marmora, on the Avellino, offers a minimum theoretic horse power of 160,000, of which 20,000 at least might be conveyed fifty kilometres or more from the source, through the medium of compressed air, and a great deal more cheaply than an equivalent amount of power could be created by steam at the place where it is applied.

These calculations seem conclusive; and if it is true that they are in all respects correct, and that they embrace all the sources of loss attendant on this mode of transmitting power, they must be regarded as being conclusive in fact. It is to be borne in mind, however, that whenever air, or any other elastic fluid, is compressed by force, there is generated an amount of heat which is the exact equivalent of the force employed in the compression, and which elevates the temperature of the air compressed. Were this elevated temperature to remain permanent, it would be reconverted into force on the subsequent expansion of the air in working, and no loss would result. But as the original temperature is that of the weather and of all surrounding things, the temperature of compression is above the general level, and in the natural tendency of heat to equilibrium, it must soon disappear. If the air, after compression, were to be imprisoned in a receiver of invariable capacity, the fall of temperature would be attended with a corresponding fall of pressure; and as the work which by re-expansion, after compression, air is capable of performing, is dependent upon pressure and volume conjointly, there cannot but occur here a serious loss. There is actually a loss, by cooling, of exactly as much power as was employed in the compression; but as the air, in consequence of its change of density, remains still under a pressure much superior to that of the atmosphere, it is capable of still doing work, and if allowed to expand will do it at the expense of the heat which it contains at the natural temperature. In its expansion, its own temperature will accordingly be depressed, but not by any means so much as it was raised during compression.

The amount of the loss resulting from this circumstance admits of being exactly computed. It will vary with the absolute pressure to which the air is subjected. To take the case at Bardonneche where a pressure of six atmospheres is aimed at and secured, for every hundred horse-power employed in compression, sixty horse-power only remains available after the heat produced by compression has passed away. In this case, the air, instead of being reduced to one-sixth of its volume by the force which raises its pressure to six atmospheres, as it would be if there were no heat generated, actually begins to enter the reservoir when its volume is reduced only in the proportion of 3.6 to one. Its density is therefore 3.6 times that of the common air. As the reservoir into which it is driven at Bardonneche is not one of invariable capacity, but is maintained by a hydraulic head under the constant pressure of six atmospheres, its density increases as it cools, and becomes equal to six, when at length it has attained the original or normal temperature of the weather. But this increase of density is attendant with a correspondent diminution of volume, while the pressure remains unaltered, so that the amount of work it is capable of doing is reduced just in proportion to the contraction, that is, in the proportion of 6 to 3.6, or one to six tenths.

If it were designed to employ higher pressures, the loss would be in still greater ratio. Thus, should air be forced into a reservoir under a hydraulic head equal to eight atmospheres, it would happen that for every one hundred horse power of compressing force expended, there would ultimately remain only fifty-five horse power available for subsequent use. At a compression of eleven atmospheres (more exactly 10.845), the loss would amount to precisely one-half. On the other hand, at a compression of only four atmospheres, there would be secured sixty-seven per cent of the compressing power; at a compression of three atmospheres, seventy-three per cent; and at a compression of two, eighty-five per cent.

The engineers of Mont Cenis have taken no account of this very serious source of loss. They do not fail to recognize the fact that a loss occurs, but they treat it as unimportant. Their only notice of it is in the following paragraph:

"There is a final consideration to be mentioned in regard to the compression of air, which, to say the truth, interests rather physical science than the practical application of the system of compression. Air, when compressed, abandons a part of its latent heat, which becomes sensible and diffuses itself among surrounding media. We fail of data to enable us to judge of the degree of influence which this fact infallibly exercises upon the motive power which operates the compression; we can say, however, on the other hand, that industrially speaking, it is of an importance so small that it may be entirely neglected. At any rate, our provisions for estimating the disposable force necessary to produce a certain quantity of compressed air having been founded always upon experimental data derived from the effects of compression actually performed, we have thus made allowance for the resistances proceeding from this phenomenon, and we can accordingly defer its more accurate study, which we reserve for future attention.

"Meanwhile we cannot but suggest that the fact of the production of heat in the compression of air giving place to the inverse phenomenon when the air resumes its original volume—this second fact is for us in the highest degree advantageous. The air flowing into the extremity of the gallery, at the tension of six atmospheres, in resuming by dilation the tension of the common air, absorbs from surrounding media the same quantity of heat which it had emitted in the act of compression; and this absorption of heat tends to depress the temperature of the gallery, which is naturally elevated, and is made more so by the presence of the workmen and by the combustion of the lamps and the gas beaks."

The authors of the report, by deferring to the future the more particular study of the influence which the compression of air must have upon the economical value of this mode of transmitting force to distance, have permitted themselves to fall into a serious error. They have failed to detect the fact that the loss is not unimportant; and they have assumed too hastily that the heat taken up by the air in expanding, is equal in amount to that which it had emitted while undergoing compression. The difference is very large. To them, and for the purposes which they had in view, it was indeed a matter of no practical importance whether, abstractedly considered, the mode was economical or not. The force was needed in the tunnel; compressed air offered the most advantageous expedient for introducing it there, and the water-power required to compress it was withdrawn from no useful purpose, but was running to waste. The question whether or not the fraction of this wasted power which was turned to account, was or was not the largest possible, was a question of secondary importance so long as this fraction was adequate to the work to which it was to be applied. It is sufficiently evident, nevertheless, that the compressing engines established at Bardonneche, have never produced, in practice, the quantity of compressed air which was expected from them.

The construction of these compressors is very simple. They operate by applying the living force of a large column of water descending in an inclined tube, to drive a body of confined air into a receiver, within which there is maintained a constant pressure of six atmospheres by means of a hydraulic head. Each compressing engine resembles therefore, substantially, a huge inverted siphon, having the long arm inclined and the short arm vertical. The cross-section of this siphon is uniform throughout, except at a point in the long arm near the bend, where there is introduced a valve for the purpose of regulating the periods of motion, and rest of the contained water column. At this point the tube is enlarged so as to make the valve opening equal to the full cross-section of the tube, and the valve itself, which is a spindle or puppet valve of peculiar form, somewhat ovoid in shape, or resembling rather a boy's peg top, drops in opening into a chamber formed by the enlargement of the tube, of such dimensions that the annular space allowed for the flow of the water around it is still equal to the same cross-section. These precautions are taken to prevent the loss of living force by any change in the velocity of the moving mass.

The short arm of the syphon is the chamber into which is introduced the air to be compressed. At its upper extremity it communicates by a valve with the receiver of compressed air. This valve is kept closed by the pressure of the air in the receiver, so long as the pressure beneath it is less; but when the air beneath attains, by compression, the same tension as that already in the receiver, the valve opens and the new charge enters.

The compression chamber, or short arm of the syphon, receives its successive charges of air from the atmosphere by valves opening inwards. It is freed from water after each pulsation or act of compression by means of other valves, which open at a level somewhat above the bend of the syphon, so that the bend itself and the long arm remain always full of water.

The action of the machine will now be easily comprehended. The air-chamber being full of air at the ordinary density of the atmosphere, the great valve in the long arm of the syphon is opened, and the water rushes through the bend into the short arm, compressing the air before it, and finally driving it into the receiver. The water then comes to rest, the large valve of the long arm closes, the discharge valve of the short arm opens, the water escapes, and a new charge of air enters.'

The difference of level between the head of the driving column of water and the point of discharge is twenty-six meters. The diameter of the tube is sixty centimetres, and the height of the air-chamber, measured from the level of discharge at bottom to the valve opening into the recipient at top, is four metres. These measurements would give, for the total capacity of the air chamber, 1.13 cubic metres; and this is the maximum charge which the machine is capable of compressing at a single impulse. The charge actually compressed, however, is less than this, and is determined by the condition that the resistance which it opposes to the driving force, during its compression and subsequent passage into the recipient, shall exhaust this force exactly, without excess or deficiency. In case the resistance is in excess, a portion of the air will fail to pass into the receiver, and so be lost. In case it is in deficiency, a portion of the motive power will be uselessly expended, and, moreover, the column of water will strike the top of the air-chamber with violence, and may damage the machine. The practical adjustment of the bulk of the charge to the power of the engine is attained by a tentative process, a series of small valves being adapted to the side of the air-chamber in a vertical row, through which the air can escape, but which the water, by its inertia, closes successively as it rises. If, in a series of experiments, these valves be secured one after another, beginning at the top, the charge of air will be gradually increased, until at length it is found to have the volume required.

There are at Bardonneche ten of these compressors constantly at work, each one making three impulses per minute, or 4,320 per day. If the charge at each impulse were equal to the capacity of the air chamber, the total volume of air compressed daily would be 48,816 cubic metres, which, reduced to one-sixth its bulk, would occupy in the receiver a space of 8,136 cubic metres. It appears that the volume actually compressed amounts to only 23,400 cubic metres, so that the charge in the compressor is but fifty-four hundredths of one cubic metre at each impulse.

If we make a comparison now between the results actually reached and the compressing force employed, we shall see that the loss in practice has proved considerably larger than that which, according to the foregoing statements, theory would indicate. The power of each compression machine is equivalent to that which would be generated by the descent of a vertical column of water twenty-four metres in length and sixty centimetres in diameter through a space of four metres, three times per minute through the day. The calculation shows that this would a little exceed an eighteen horse power. The whole ten of the compressors furnish, accordingly, a horse power of 180.

On supposition that the compression chambers are entirely filled with air at each impulse, this power will not be equal to the work imposed upon it. But if, instead of 1.13 cubic metres, there be admitted only 0.78 cubic metres at each charge, the total resistance will be exactly equal to the power. Were not heat developed by the compression, the charge might be made as large as 0.94 cubic metres, and the total amount of daily compression would be 40,608 cubic metres. It would seem, from the dimensions adopted, as if the original expectation had been to compress one cubic metre at each pulsation of each machine. Had that expectation been realized the compression would have reached to 43,200 cubic metres daily, reduced to 7,200 cubic metres in volume. The power employed is actually capable of compressing 33,860 cubic metres daily, to a bulk under the pressure of six atmospheres of 9,500 cubic metres, becoming by subsequent contraction 5,700 cubic metres. But the amount actually compressed is only 23,400 cubic metres daily, giving ultimately 3,900 cubic metres of compressed air at the normal temperature. This represents a compressing force of only 125 horse-power, being less, by fifty-five, than the theoretic force of the compressors.

The 3,900 cubic metres, at the pressure of six atmospheres, are capable of producing an amount of work hardly equivalent to seventy-five horse power. There is, therefore, a loss at Bardonneche, from causes known and unknown, equal to seven-twelfths of the hydraulic force employed.

It is probable that a part of the loss unaccounted for as above may be a necessary consequence of this mode of applying the *vis viva* of an inert mass in overcoming elasticity. In order to avoid injury to the machine, and also to prevent water from passing along with the air into the recipient, the charge must be large enough. The danger is that it will be made too large, and that a part of the compressed air will fail to enter the recipient. All the force expended upon this portion is thrown away. Another part of the loss may be due to the inertia of a body of water occupying the bend of the siphon, about two cubic meters in bulk, which comes to rest after every pulsation, and opposes the movement of the driving column. The same hydraulic power, or an equivalent steam power, would probably be applied more effectually in compressing air by means of pumps, than in the method above described. This the engineers themselves appear to have tacitly admitted, by introducing pumps at the northern entrance of the tunnel.

It must be finally observed, as having an important bearing upon the question of economy in regard to this mode of transmitting power, that the work which remains stored up in compressed air, after the important deductions we have found it necessary to make, cannot be fully recovered without working the air expansively down to the pressure of the atmosphere. If it has been compressed to six atmospheres, it must be expanded more than three and a half times; if to eight, nearly four and a half; if only to three, to two and a quarter times. At Bardonneche, where the perforators work without expansion altogether, half the power is thrown away.

If we apply the results which we have thus reached, to the example above quoted from the report of the engineers of Mont Cenis, we have to make some important modifications of the results there presented. The proposition is, to carry to a distance of twenty kilometers, by means of a tube thirty centimetres in diameter, a force represented by an efflux of four hundred and twenty-four cubic decimetres of air per second, under a pressure of six atmospheres. It is first necessary to recompute the value of the power which this discharge is capable of affording. The engineers have assumed, what would be true according to the law of Mariotte, viz., that the pressure of an elastic fluid is inversely as its density; that each litre of the air delivered, as above supposed, would represent a power of work equal to one hundred and ten kilogrammeters. Taking into account, however, the depression of temperature attendant on expansion, this power must be reduced to 61.41 kilogrammetres only. But we must increase this again by the amount of force which the air exerts in being introduced into the working cylinder of the machine which it operates, that is, by the amount of sixty-two kilogrammeters per liter; so that the actual force which each liter represents will be carried up to 123.41 kilogrammetres. A supply of four hundred and twenty-four litres per second, with this value, will then furnish a horse power of six hundred and ninety-eight, say seven hundred; but in order to produce it, there will be required an original expenditure of eleven hundred and seventy-five horse power.

Since, moreover, it appears that the resistances of the tube will call for an increase of the pressure at the source to eight atmospheres, a corresponding addition must be made to this original expenditure. Supposing the volume of air condensed to remain the same, but to be compressed, as above required, to eight atmospheres, the force necessary for this compression will be no less than 1,350 horse power, and the force which the air so compressed would be capable of exerting, if used on the spot, would be only 740 horse power. At the distance of twenty kilometres, it would fall, as above, to 700; so that the loss from all causes would amount to nearly fifty per cent.

It is, therefore, evident that, under the conditions which we have been considering, that is to say, in the use of great pressures and tubes of moderate dimensions, compressed air does not furnish an economical mode of transmitting power. At lower pressures the original loss is less, and in tubes of larger diameter the resistance in the movement of transmission is less. A tube of fifty centimetres in diameter will deliver the same volume of air at a velocity but little more than two metres per second, and with a resistance of only seven and a half millimetres of barometric pressure per kilometre of distance; which, for twenty kilometres, amounts to one-fifth of an atmosphere.

Supposing this air to be originally compressed to three atmospheres, it will deliver a power of 260 horse at a distance of twenty kilomemetres, with an expenditure at the source of 400 horse power. This will be sixty-five per cent of the whole. Of the loss, thirty-five per cent in all, twenty-seven per cent will be incurred at the point of compression, and eight per cent in consequence of the resistance of the tube. At the distance of fifty kilometres, or thirty miles, the power delivered will still amount to 220, or fifty-five per cent of the original expenditure.

It may be interesting to compare this result with that which would be obtained in the application of Mr. Hirn's telo-dynamic cables to the transmission of a similar power to an equal distance. His allowances for losses are two and a half per cent of the whole power for the resistances of the two great pulleys at the termini, and eighty-four kilogrammetres per kilometre of distance for the friction of the pulley supports. To these must be added the effect of the resistance of the air and of the rigidity of the cable. On 400 horse power the first deduction would be ten. The friction on the pulley supports in fifty kilometres would consume fifty-six horse power more. For the determination of the resistance of the air to the pulleys, the data are imperfect, but an approximate estimate may be formed by considering that the velocity at the circumference of the pulleys is thirty metres per second, and has been carried to forty metres. At thirty metres of velocity the resisting pressure of the air upon a moving body is more than one hundred and twenty kilograms per square metre of surface directly exposed to it. Each pulley has eight spokes, exposing each a surface of three or four one-hundredth parts of a square metre, say one-fourth of a square metre in all. If we take the atmospheric resistance due only to two-thirds of the circumferential velocity, which resistance is fifty-four kilograms per square metre, the force required to overcome it will amount to 13.5 kilogram metres for each pulley, or to twenty-seven for the pair of pulleys, and to one hundred and eighty-nine, equal to two and a half horsepower for the seven pairs in a kilometre. Fifty kilometres will, therefore, consume one hundred and twenty-five horse-power, which added to the consumption above computed for friction, will give a total of one hundred and ninety-one. This being deducted from the entire original force, will leave two hundred and nine horse power; the resistance due to the lateral friction of the air, and to the rigidity of the cable being still to be allowed for. It follows that, for great distances, the transmission of power by compressed air may compete favorably with the only other mode of transmission which could be substituted for it, while, for moderate distances, it is economically inferior. For great distances, whatever mode of transmission be employed, there must always be a very considerable loss. This will be true even with water, whether conveyed in canals or in tubes; while water-power can only be so conveyed to points at levels lower than the source.

There are parts of our country in which the means of transmitting power to distances are of high importance. In certain portions of our mineral regions the possession of a few hundred horse-power may make to a whole community all the difference between poverty and wealth. If this power can be obtained from the distant mountain torrents by either of the methods which we have been considering, it is certainly better to submit to the loss which they entail than not to obtain it at all.

There is an incalculable amount of force constantly wasting itself in the natural world, which never will or can be applied to any useful purpose at the points where it is developed. If the half or the third or the tenth part of such a force can be transported into the heart of an industrial community, the abstract economy of the means of transportation is a matter of secondary importance, provided there are no better means. It may, therefore, be justly concluded that the use of compressed air as a medium for transmitting power, if not theoretically as advantageous as at first thought it might seem, may, under circumstances of not very unfrequent occurrence, be an invaluable expedient for turning to useful account, powers which would otherwise be wholly unavailable."

Thus far compressed air has only been used to any considerable extent as a motor in mines and tunnels. Mr. Horace H. Day has conceived the idea of making the waste water power of natural falls available by transmitting such power directly into the heart of cities and manufacturing towns. One plan is to transfer power from the lower falls of the Genesee river into that part of the city of Rochester where it can be most advantageously used, a distance of about one mile and a half. The other is a far more gigantic undertaking, being no less than carrying compressed air from Niagara Falls, by means of a wrought-iron pipe three or four feet in diameter, to the city of Buffalo, a distance of about twenty miles.

Mr. Day has recently tried some experiments in compressing air, by means of water power, on a small scale, at Bloomingdale New Jersey. His first object was to test the efficiency of a new device, which was claimed by the inventor to materially reduce the loss by friction in passing air through long pipes. His experiment proved what theory very plainly taught, that the absolute smoothness of the interior of air pipes was of the first importance.

The pipe used for conveying the compressed air at the last trial of the apparatus, was about a mile and three-quarters in length, one mile of which had an internal diameter of three-quarters of an inch. The form of compressor did not differ essentially from an ordinary air pump, and although no means were provided for correctly estimating the amount of water power expended in performing a given amount of work by means of compressed air, it demonstrated, on a small scale, that within certain limits, power might thus be generated and used in this manner with great advantage in certain localities. Mr. Wm. S. Henson, an engineer of Newark, N. J., has made a report of experiments conducted by him with this apparatus, to which reference is now made for the details of these trials. Some of the deductions of Mr. Henson are open to criticism, especially that in regard to resistance arising from the velocity of flow, for he says that these experiments demonstrate the existence of the following law, viz.: "That the loss per cent of the whole power from friction in transmitting a given mass, or, more properly speaking, weight of air through a pipe of given dimensions, diminishes inversely, in a geometrical progression." In his experiments the divisor or ratio being two, for every increase of ten pounds pressure.

Now the law established by the experiments made by order of the Italian government, and with which Mr. Henson comes in conflict, is that "The resistance is as the square of the velocity of flow." This law is independent of pressure, as it should be, for when the question relates to mass delivered, the expressions for friction will be exactly equal. The flow in the tube required to deliver a given mass, in a given time, must be inversely to the compression, provided the temperature is the same. The velocities in the several pressures used must have been 1, 1-2, 1-3, 1-4 and 1-5; and the resistances were as 1, 1-4, 1-9, 1-16 and 1-25. So that the diminution of resistance, as reported by Mr. Henson, was not as great as it should have been, according to the law demonstrated by the Italian experiments. The Chair concluded his remarks with the hope that the discussion of the subject before them would elicit new views, and set forth clearly all the conditions requisite to a successful employment of compressed air as a motor.

Dr. John F. Boynton described the geologic formations at Rochester, and predicted that twenty or thirty years hence the center of the city would be at the lower falls; especially if it should be found that the compressed air could be sent through pipes, furnishing a blast for blast furnaces, power for machinery, and even in private houses furnishing power where required, aiding in kindling fires, as easily as water and gas are now distributed through cities. Two objections had been raised, which it was desirable to consider; first, that as the air is compressed, it will radiate heat, which will be lost; and second, that in its expansion it will absorb heat, and have a cooling effect, so that it will require a different lubricator from those employed in steam engines.

Horace H. Day.—Two years ago, having come into possession of a fall of 206 feet, at Niagara, on the American side, and having no use for the power there, I applied to two or three eminent engineers to know if it were possible to utilize the power in Buffalo. Much mystery was thrown around the subject by them; but they gave me no encouragement. During the past year my attention has again been called to the subject, and in order to decide the question, I have had, during the last eight months, a series of experiments conducted at Boomingdale, N. J. The results are stated in a report by the engineer who conducted the experiments (Mr. Henson), and who will read it to-night. After the compressed air has passed two miles, it is in a cold state. I conceived the idea of increasing the force by heating it; and I have found that by passing the cold air through the chamber of a boiler, I obtained very greatly increased force, much more I think than could have been obtained directly from the coal used to make the steam.

Mr. W. S. Henson, of Newark, N. J., read the following report:

BLOOMINGDALE, N. J., *November*, 1870.

MR. HORACE H. DAY: Dear Sir—In accordance with your request, I submit to you the result of my observations of your experiments at Bloomingdale, in the compression and transmission of air through pipes as a means of utilizing power at long distances from its source. In order to carry out your demonstrations and experiments, you have laid two miles of pipe; that is, two separate and distinct pipes of one mile each, both of lead, and one and a quarter inches diameter (inside measure); one mile reaches from a mill situated about three-fourths of a mile off, and in its course passes over the side of a mountain, which I rightly estimated at about 300 feet high, and over very rough, uneven ground, the mile being completed by passing partly round a field adjoining your place, and then terminating in your mill. The other mile of pipe starts from your mill, passes twice round your premises and an adjoining field, and then runs about 500 feet along one side of the field and back again to complete the mile, terminating at your mill. Both pipes run over very rough, uneven ground, and are full of crooks, bends and angles, the weight of the pipes having caused them to assume the profile of the ground. There is an air-compressor and a receiver for each pipe; each air-compressor consists of a horizontal cylinder, five inches diameter, and provided with suitable valves at each end, and a piston driven by a crank and pulley, like a common, double-acting steam engine reversed and used as a double-acting pump; each receiver consists of a cylinder thirty feet long and sixteen inches diameter, made of boiler-plate, and strongly riveted. One compressor and receiver is located at the mill, three-fourths of a mile away, and is driven by the water-wheel there; the other compressor and receiver are situated upon your own premises, and the compressor is driven by a small turbine wheel, of about two and a half horse power. Each compressor pumps the compressed air directly into its own receiver, situated near it, whence it flows into the connecting pipes, which both terminate at your place, where there is an excellent vertical cut-off steam engine of A. K. Ryders's patent, having an eight inch cylinder, ten inch stroke, estimated at seventeen horse power, built by the Albany Street Iron Works, New York. The cut-off is admirable for its simplicity and effectiveness, and the design and workmanship of the engine reflects great credit upon the constructors. The pipes are so arranged in connection with this engine, that it can be driven by either compressor alone, or both connected, or the air from the compressor, situated three-fourths of a mile off, can be sent through the two miles of pipe in succession.

The theoretical power required to drive one of these compressors 100 revolutions per minute, when compressing to seventy-five pounds above the atmosphere, or six atmospheres altogether, is estimated at 5.87 horse power, plus the friction. This calculation is based on the well known law of Mariotte, viz.: That with equal temperatures the pressure is inversely as the volume, as although there is generally a considerable increase of temperature in the act of compressing air, yet with good compressors this heat can be so nearly all absorbed that Mariotte's law will practically hold true.

In 1837, a series of experiments were made by order of the Italian government (preliminary to the commencement of the Mont Cenis tunnel) on the resistance of tubes to the flow of air through them, one of the principal objects being to ascertain the laws which govern the variations of resistance, when the velocities of flow and the diameters of tubes are varied, as well as to determine the practicability of using compressed air in driving the tunnel. From the results of these experiments the three following laws were deduced as reported by President Barnard (see his able report on the Paris Universal Exposition for 1867, republished by Van Nostrand, New York):

1st. "The resistance is directly as the length of the tube."

2d. "It is directly as the square of the velocity of flow."

3d. "It is inversely as the diameter of the tube."

And your experiments, as far as they have gone, have confirmed the substantial truth of the first and third propositions, and demonstrated the existence of another law of vast importance to the practical transmission and application of the power of compressed air through pipes for long distances, viz.: That the loss per cent of the whole power from friction in transmitting a given mass, or, more properly speaking, weight of air, through a pipe of given dimensions, diminishes inversely in a geometrical progression, the divisor or ratio being two for every increase of ten pounds pressure, as may be seen by inspection of the following table, obtained from actual experiment. The pressure gauges used in these experiments are the same kind as those ordinarily used on steam engines, and made by E. H. Ashcroft, the dials being marked at every five pounds, and the intermediate divisions measured and read by the eye alone.

The pipe used is one of the two mentioned above, one mile long and one and a quarter inches diameter, commencing and terminating on your premises; the air compressor being one situated on your place. The pressure gauges being located both in the same room, could be readily compared with each other, the first gauge being placed near the beginning of the mile of pipe, and the second gauge at the end of it; and the readings are as correct as I could measure them by the eye alone. The water power driving the compressor was so regulated as to deliver the same weight of air at each experiment; that is, 120 cylinders full per minute, five inches diameter and twenty inches long. The velocities are calculated from the volumes due to the pressures, according to Mariotte's law; and the pressure at the second gauge was obtained by partially closing a valve attached to the end of the pipe until the desired pressure was obtained, and at which both gauges remained constant, without further adjustment, some fifteen or twenty minutes. The second table below was obtained from the first by calculation up to 100 pounds.

Number of strokes of compressor per minute.	1st gauge pressure, in pounds.	2d gauge pressure, in pounds.	Velocity at beginning of pipe, in feet, per second.	Velocity at end of pipe, in feet, per second.	Mean velocity, per second.	Loss from friction, in pounds.	Loss per cent of the whole power delivered by compressor.	Per centage of loss calculated from last column.
120	22.00	10	21.60	32.00	26.00	12 00	54.50	54.50
120	28.00	20	18.06	22.60	20.60	8.00	28.57	27.25
120...	35.25	30	16.00	17.80	16.90	5.25	14.89	13.67
120...	43.25	40	13.66	14.33	13.99	3.25	7.51	6.83
120....................	51.75	50	12.00	12.26	13.13	1.75	3.38	3.41

SECOND TABLE.

	61.030	60	......	10.66	.....	1.030	....	1.700
	70.596	70	......	9.38	.....	0.596	....	0.852
	80.341	80	......	8.46	.....	0.341	....	0.426
	80.192	90	......	7.62	.....	0.192	....	0.213
	100.100	100	......	6.93	....	0.100	....	0.106

It will be observed that if the per centage of loss in the eighth column, commencing at the top, is divided by two, it will give 27.25 in the ninth column, second line; and that again divided by two gives 13.67; and if this process is continued in succession, it ends with 3.41 in place of 3.38, as got by experiment; and by continuing the same process, the last column of the second table was obtained. It will be also observed that a very slight variation in the readings of the gauges would make the differences between the eighth and ninth columns in the first table.

These results, while demonstrating the necessity of a high degree of compression, say from eighty-five to one hundred pounds per inch, to reduce the loss resulting from transmission through long distances of pipe, are at the same time extremely favorable, as for transmitting great quantities of power the air requires to be considerably compressed, and both objects are thus gained by high compression.

These experiments, made alone by myself with great care, to discover the cause of observed variations, are entirely confirmed by reference to your records, extending through several months, and made before we were looking for or were conscious of any law on the subject.

In response to your request for the elements necessary for the transmission of 5,000 horse power from Niagara Falls to Buffalo (about twenty miles), using your magnificent power of 206 feet fall, I suggest the utilization of 185 feet of this fall by the direct compressing power of a column of water acting as a ram, without the intervention of water wheels or the friction of cylindrical compressors with moving pistons, because by the use at *that point* of such compressors, you absorb the heat generated in the act of compression and avoid the loss from friction by piston or cylinder, and all the wear and tear of ponderous water wheels.

This direct acting hydraulic pressure, working in one sense as a ram, may be made to develop any amount of pressure desirable, and taking into account the cost of pipes and other considerations, I would suggest that the pressure should not be less than eighty pounds or more than 100 pounds per square inch; and a pipe of forty-two inches in diameter would transmit from Niagara Falls to Buffalo a column of air compressed to 100 pounds, with a velocity of ten feet per second, and a loss from friction of tube, for the whole distance, not exceeding one per cent of the power transmitted, and deliver for use over 5,000 horse power of cold air. I should recommend, however, a pipe of thirty-six inches diameter, which should deliver a column of air at 100 pounds pressure, and 14.33 feet per second terminal velocity, and give a full 5,000 horse power of cold air, worked expansively at a loss by friction not exceeding five per cent for the twenty miles.

Great unnecessary loss would result if common non-expanding steam engines were to be used to work off the power; and the more perfect the compressors for condensing the air, and the greater the excellence of the steam engines, the better.

You propose to construct the pipe with boiler plate, one-fourth inch thick, and paint it, both inside and out, with a strong, indestructible varnish, whereby it will not only be rendered absolutely air-tight, but will be perfectly protected from corrosion.

Before closing my report, I will only refer to your experiments for expanding the compressed air, at the moment of its use, through the steam engine. As you are taking out patents for your discovery, I need only remark, that in my judgment, it will contribute in no small degree toward that growing appreciation everywhere manifested by the intelligent public for compressed air as a motive power.

Professor Charles S. Storrow, an eminent engineer of Massachusetts, and the commissioner employed by that State to proceed to Europe to examine the works there going on, and especially that for tunneling the Alps, to discern the practicability of finishing the Hoosic tunnel by compressed air, in the closing part of his report, introducing a minute description of the process practiced at Mont Cenis, uses the following expressive language, which is so just and appropriate that I may be excused for quoting it here:

"For the construction of the tunnel, the great instrument in the hands of the engineer is compressed air; and what an instrument it is! By its aid, they furnish air for respiration, wind to drive away vapors, power to run machines. They eject water to play against the rocks, produce cold to temper the atmosphere, and heat by a blast of the forges near the entrances. Thus air, wind, power, water, cold, heat, can be applied, and precisely where they are wanted. This sounds like fable, but it is a literal truth."

W. S. HENSON.

Mr. Benj. T. Babbit was called upon to describe apparatus which he was constructing; but he stated that his experiments, which would cost $10,000, would not be completed for some months.

Mr. Henson.—I observe in Dr. Barnard's report the expression that the whole of the power employed in the compression is lost by cooling. I should like to hear that explained.

Mr. J. K. Fisher.—There are two ways in which the air works, one by expansion and the other passively by being pushed. I think that what he means is lost is the difference between the power required to compress the air and the power it gives out after having parted with its heat. That part of the air which is pushed along loses nothing, as I understand it, except by friction.

Prof. J. A. Whitney.—One of the earliest attempts to convey power by compressed air failed from faults in the pipe. There will be trouble from that source in these days. We know that oxygen gas is safely carried in tubes at a pressure of 300 pounds to the square inch. A column of air was transmitted through tubes for railways, forty years ago, keeping up a pressure of nine pounds to the inch, and giving a speed, on one occasion, of seventy miles to the hour. To me the great difficulty seems to be, practically, the loss by heat. If a certain amount of heat is radiated from the tube we cannot get it back and use it as power. The question arises, therefore, how shall the conductivity of the tube for heat be diminished. But I think it will be found impracticable to regain this power by re-heating the air, as proposed. That experiment has been tried with steam-engines. Two years ago that was claimed to give seventy per cent more power. A year ago forty per cent was claimed; and it will not be long, at this rate, before we reach the truth, which is, I apprehend, that we might as well use the coal in heating an equal quantity of air without sending it so far. We must provide tubes as smooth as we can and as straight as we can. Then we may deduct thirty per cent for the power lost. But if we get seventy per cent of available power, it is more than we get, on the average, from a water-wheel.

Mr. Day.—During the last year I have expended $18,000 to get knowledge on this subject; and I should like to learn all that I can of the laws governing it. In our operations in New Jersey we take out the heat in the act of compression, and do not pass it along the pipe at all. Therefore we have not that load to carry.

Prof. Whitney.—When we heat air it expands, and we get a certain measure of power, provided we expand it against resistance. When we abstract heat from air it contracts. Compressing air we render evident the heat that was previously latent in it, and it passes off; and the difference between the power given out by that air when compressed and the power which would be given out if this radiation were prevented is just the power we should get by applying that heat to the expansion of other air.

Mr. Fisher suggested that one use for compressed air in the summer would be for the ventilation of dwellings, the expansion of the air cooling it in proportion to the amount of heat radiated in its compression.

The further discussion of this subject was postponed until the next meeting.

Adjourned.

December 22, 1870.

Professor S. D. TILLMAN in the chair; ROBERT WEIR, Esq., Secretary

PULVERIZED ORES SEPARATED BY MEANS OF THE AIR JETS.

Mr. Krom exhibited specimens of materials of nearly equal specific gravity separated from each other by his machine. He had long since succeeded in separating zinc blende from galena with facility, their specific gravities being 4.0 and 7.05. He had now succeeded in separating spathic iron from cryolite, their specific gravities being 2.9 and 3.9. The difference of specific gravity of diamonds and sand is greater than this, diamonds being 3.5 and sand 1.8, quartz sand being 2.6. Other precious stones, as topaz, sapphire, ruby, have a specific gravity of about 4.0. The gravel might be passed through the machine at the rate of eight or ten tons per day, and the precious stones would be separated. The apparatus by which this is effected contains a pair of bellows, moving about an inch and giving about 450 currents a minute. With water you can get but 120 of these intermittent currents in a minute, and the separation of zinc and lead is all that it can accomplish.

The annexed table of specific gravities, water being equal to one, will show which materials can be most readily separated:

Dry sand	1.420
Common sand	1.670
Common gravel	1.743
White flint	2.594
Quartz	2.660
Rock crystal	2.735
Turquoise	2.750
Brazilian diamond	3.444
Oriental diamond	3.521
Sapphire	3.994
Topaz	4.011
Ruby	4.283
Galena	7.500

The following articles from *Watson's Art Journal* were presented:

ON A NEW MUSICAL NOTATION.

Read before the National Musical Congress of 1870, at Steinway Hall, New York, by
Samuel D. Tillman, LL.D.

Symbols are the necessary outgrowth of systematic conceptions, therefore a notation may be a true index of progress. In acoustics, and other branches of natural philosophy, the ancients made but small advance for the want of correct measuring instruments. How much they accomplished in music is not now known, since they have left no record of musical conceptions. The Greeks advanced so far as to denote differences in the pitch of musical sounds by alphabetical and other characters, and to arrange these sounds in different orders which were designated as modes, but they had no symbols to denote duration, rest, rhythm, or dynamics. Their music was chiefly vocal, and, being learned by rote, was liable to undergo many changes. Strings and pipes were tuned to their different modes, and were used as accompaniments to the voice. The muses of Epic and Erotic poetry were represented by the ancients holding musical instruments. Sappho, Anacreon and Pindar sang their own compositions. Their performances may have resembled chanting, but more probably, they were of that semi-musical character now called recitative.

Music, as a fine art, had its origin in the Christian church. In the the sixth century Pope Gregory first recognized the fact that the diatonic scale consisted of seven sounds; and, as the extension of this scale, either upward or downward, gave sounds similar to the first series, he determined to designate the series by the first seven letters of the alphabet, commencing at the tonic in the minor mode, and to apply the same letters, slightly modified in form, to each similar series of higher or lower sounds. No further improvement in musical notation was made until Guido Aretinus, of Tuscany, early in the thirteenth century, introduced the solfeggio, and the staff of five lines, on the spaces and lines of which he made dots, upward and downward, to denote sounds of higher and lower pitch. These dots were afterward so modified as to express the length or duration of the sounds. Various other improvements were subsequently added, and after the lapse of several centuries a complete system of harmony and counterpoint was introduced, and the notation then embraced all the characters now used. In the meantime, the rates of vibration producing sounds of different pitch were found to have fixed mathematical relations, and the laws of harmony became an important branch of acoustics.

The complications in this present notation arise from two causes. 1st. In order to dispense with the use of leger-lines it was found essential to introduce three clefs, represented by distorted Gothic letters, which respectively defined the position on the staff of the sounds known as F, C and G, and consequently the position of the other sounds of the diatonic scale. As the clefs may be used on any line or space of the staff, it follows that the signs belonging to the diatonic scale could have seven different interpretations, although in common practice they have only three. 2d. A change of the tonic from A, in the minor mode, or C in the major mode, of the so-called natural key, to any other position, involves the use of other sounds, which are represented by placing the sign of a sharp or flat before either note of the natural key, thus indicating that such note is to be raised or lowered in pitch a, so-called, semi-tone. As the seven different positions given to the sounds of the diatonic scale may be virtually changed to two other positions by means of flats and sharps, the whole number of different interpretations would amount to twenty-one. In most of the printed music now used, only two clefs are found, and these respectively give F and G but one position, so that the different interpretations commonly applied to the same note on the staff amount to four.

Although this complicated system enables the musician to sing or play correctly, it does not always indicate with absolute accuracy, the true pitch of the note represented. This point may be illustrated by a single example. In the key of C, the first interval—that is, from C to D—is approximately measured by nine commas; and the next interval, from D to E by eight commas. If the tonic is changed from C to D, the next sound above it must be nine commas more acute than D; yet we see that in the first key used, the true E was only eight commas more accute than D; therefore, this sound, E, does not belong to the series of true sounds used in the key of D. The two sounds known as E in these two keys, differing in pitch about one comma, are represented in the notation as identical. In true modulation, much greater differences arise, which cannot be indicated by the common music signs, but which the vocalist or violinist, by the ear alone, is able to render correctly. True intonation can only be given by instruments of the violin and trombone classes, to a limited extent by the euharmonic organ, and by the human voice. The harp, piano, organ, melodeon, and all hand instruments operated by keys, are necessarily constructed according to a tempered system of intonation, by which a sound is so modified in pitch that it may be substituted for the true sounds belonging to the different tonics, and thus twelve, sounds compose the tempered chromatic scale of each septave.

This admirable tempered system has greatly simplified the execution of difficult musical compositions, and enables a single performer to render several parts simultaneously on instruments like the piano and organ.

The query naturally arises, cannot the notation be adapted to this tempered system used on all keyed instruments, and simplified by abolishing clefs, flats and sharps? Several attempts have been made to accomplish this object. Among the first was that by the celebrated Jean Jaques Rosseau, who, in 1742, read a paper befor the Academy of Science at Paris, "On proposed new signs for music." His system, with some modifications, has been revived within a few years past; and, it is said, was successfully taught to vocalists in the Paris Conservatory of Music, under the direction of the distinguished composer, Auber. The peculiar feature of that system is the use of the figures, long employed to denote chords, in place of notes on a staff. Three serious objections may be raised against it: 1st. It introduces the old defective counting by using the numeral 8 to denote the eighth sound in an upward progression on the diatonic scale, which sound is the first note of another series. 2d. It does not provide for modulations. 3d. It gives no fixed idea of pitch, since each sound is only known and distinguished by its relation to the tonic.

Assuming that it would be highly advantageous to employ symbols of sound exactly adapted to the tempered system of intonation used on all keyed instruments, I now present the following plan. It is based on the new method of distinguishing and measuring musical intervals, laid by me before the American Association for the Advancement of Science, in which the upward progress of the pitch of musical sounds is represented by a spiral projection, each ring measuring a septave, so that a radius vector cutting them would show the position of the same note in each septave; thus obviating the difficulty met with in measuring the seven intervals of the diatonic scale on a right line, which requires the addition of a superfluous note.

In representing the intervals of the septave, as used in the tempered system, one ring of the spiral is made a circle, for convenience, and divided into twelve equal parts. These measure a tempered semitone interval, and may properly be termed the twelve grades of pitch belonging to one septave. They are numbered like a watch-dial, so that every person who carries a watch has at command a chromatic scale. The numerals 12, 2, 4, 5, 7, 9, 11, correspond with C, D, E, F, G, A, B, of the diatonic scale, and designate the seven white keys of the piano, while 1, 3, 6, 8, 10 denote the five black keys. As the natural key, or the tonic of C, is not employed more than other tonics, it seems essential not to give the sounds belonging to that key more prominence than other sounds; accordingly, in this system, all the notes are numbered by figures of the same size. By this method no allusion to flats and sharps is necessary. The notes belonging to any tonic are found by a very simple rule, namely: When the tonic is an even number, the next two notes are even numbers, and the remaining four notes are odd numbers; and *vice versa*, when the tonic is an odd number, the next two notes are odd, and the remaining four even. A single example will show the comparative simplicity of the new method. To the question, What are the notes belonging to the key of B, or the signature of five sharps? the answer, by the old system, is B, C sharp, D sharp, E, F sharp, G sharp, A sharp. By the new system, 11, 1, 3, 4. 6, 8, 10.

In devising symbols for this system, I have given each the same prominence; and they are derived from the graduated circle in this way: A square is drawn so as to include the circle; and by making three projections on each of the four sides of the square, twelve projections are formed, which are signs of the twelve notes of the tempered chromatic scale. The note C, or twelve, being represented by the center projection on the upper side of the square, the other projections pointed out by the moving minute-hand of a watch, represent in regular order the remaining notes of a scale. When one sound is denoted, only one projection is used on the square; but more may be added to show the chords belonging to that sound. In printed music these squares will be from an eighth to a sixteenth of an inch in size.

The duration of sound, or the length of a given note, is measured by means of the same square, as follows: A square having four thick or full-faced sides is a sign for a semi-breve, measuring four beats. A square with two thick sides is a minim, measuring two beats. A square with one thick side is a crochet, measuring one beat. A square with four thin sides is a quaver. The same square, with a vertical line through the center, is a semi-quaver; and the latter square, with a horizontal line added, is a quarto-quaver. A square with thin sides, having a diagonal line through it, is an octo-quaver; and this sign, with another diagonal line crossing the first, is a semi-octo-quaver, known in common parlance as a hemi-hemi-demi-semi-quaver.

When either of these symbols of duration are used without a projection, it denotes rest, and measures a like interval of silence.

If the sounds to be indicated are all in the same septave, the symbols are placed in the same right line: sounds in the next septave above are indicated by raising the symbol just above, and sounds in the septave below, by placing the symbol just below the general line. The square denoting the middle septave is known as unmarked, and that denoting the next septave above has beneath it a single horizontal line; that for two septaves above has two lines beneath it; and thus each septave above is indicated by an additional line beneath the square. In like mannner the septaves below the middle C, or 12, are respectively indicated by placing lines above the square. However, to denote the actual pitch of any sound, the 12 of the middle septave, commonly known as the middle C, is produced by 522 vibrations in a second, according to the new French standard of pitch; and the same sound in each septave downward is made by halving the vibrations respectively, and those above by doubling the vibrations for each C or 12. It is evident that by this arrangement, each grade being modified for more grave and acute sounds, and by the use of the sirene, the highest and lowest sounds perceptible to the human ear can be indicated and measured. To denote the pitch of every note of the different true scales which may be used, it would be better to dispense with such expressions as B double flat, E flat grave, G sharp acute, etc., and use a system which will at once show the absolute pitch, and its relations to the tempered system of intonation. It is true that a division of a septave into 363 parts would be required for absolute exactness, but we can adopt the division of the ordinary watch-dial into twelve parts, or grades, also sixty smaller parts, or commas, so as to express the relations of the isotonic tempered system, and the true system, and give the exact measure required; since we may assign to these finer divisions *an exact value*, so that 10, 9, 6, 10, 9, 10, 6, will indicate the true major and minor tones and the so-called semi-tone, the sum of these intervals being equal to sixty. Thus the true E in the natural key being one division less from the tonic than the tempered E, or 4, might be denoted in figures by $^{1}4$. One division greater than four being 4^{1}.

Any of the old symbols which can be printed in one right line, may be used with the new, for denoting any modifications of sound. In some cases, other well-known signs may be substituted; as, for instance, in place of the old sign placed above two notes, called a slur, or tie, the ordinary hyphen may be employed to indicate the blending of two sounds.

The new symbols are to be used like ordinary type, so that music may be set up and printed with great rapidity, when compared with the present methods. Great economy of space is secured by the new system. An ordinary piece for the piano could be embraced in a single page, thus relieving the performer from the duty of turning over leaves when the hand should be otherwise occupied. The brevity of the plan proposed is such that printed music could be added to each hymn of the ordinary hymn-book, without materially increasing its size. However, economy of space and convenience of use are matters of inferior consideration, when compared with the great object to be accomplished, which is to strip from written music every sign not essential to the use of instruments having only twelve keys for each septave, and to make the new signs as easily understood as is the actual method of using the instrument, so that we shall no longer hear of playing and singing by rote among those whose musical gifts would be greatly enhanced if unhampered by useless musical signs.

The author proposes no crusade against the old system. It is thoroughly established, and millions of dollars are now invested in music-books, and in metallic plates from which music is printed. Still, in this age of progress, we should not be true to ourselves if we did not make known what we regard to be "the better way" for accomplishing a desirable end, leaving its actual merits and importance to be determined by the unerring tests of time and experience.

PROPOSED IMPROVEMENT IN THE SOLFEGGIO.

[Substance of remarks made by Samuel D. Tillman, LL.D., at the late National Musical Congress, in the city of New York.]

I desire to submit for the consideration of this congress a proposition for changing very slightly the present solfeggio, well knowing that it is very difficult to alter terms which have had for centuries a world-wide significance.* Nearly seven hundred years have elapsed since Guido Aretinus applied his system of solmization to the diatonic scale of music. He was led to the plan by observing that the sounds given to the first syllables of each of the first six lines of a monkish Latin hymn to St. John formed a regular upward progression of pitch. The following is the hymn referred to by the speaker:

Ut queant laxis
Resonare fibris
Mira gestorum
Famuli tuorum
Solve polluti
Labii reatum
Sancte Johannes.

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* See Transactions of American Institute for 1867-1868, page 771.

Accordingly, *Ut*, *re*, *mi*, *fa*, *sol*, *la*, were the syllables used by him, instead of the letters C, D, E, F, G, A. In place of the first syllable of the last line of the hymn, *si* was subsequently used, so that *mi* and *si* indicated the sounds immediately preceding the two, so-called, semitone intervals. In some parts of Europe the syllable *Ut* is still applied to the tonic; but in England and this country the syllable *do* has been substituted, in order to give the note a full vowel sound, unimpeded by a terminal consonant. There remained only one other syllable (*sol*) ending with a consonant; but as the next syllable (*la*) commenced with the same consonant, this did not seem objectionable; for in rapidly running upward with the voice, these two syllables would be pronounced as *so-la.* However, in applying solmization to tunes, *sol* would just as frequently precede other syllables, and then the terminal *l* thus became an impediment, because, in pronouncing it, the tongue is brought to the roof of the mouth, acting like a throttle-valve, not changing the pitch, but checking the full flow of sound.

The ancient Greeks must have fully understood the importance of not impeding the flow of a prolonged sound by a consonant, since they applied to their tetrachords the syllables *Ta*, *Te*, *The*, *Tho.* The change now proposed fully carries out this idea, while it gives a new and important meaning to the syllables used. It consists in substituting for *sol* the syllable *do*, and for *do* or *ut* the syllable *to.* As the first note of the scale is always the tonic, this is indicated by *To;* and as the fifth note is always the dominant, this is indicated by *do.* No further change is required, since *mi* is always on the mediant. The chord of the first, third, and fifth, or common chord, consisting of the tonic, mediant, and dominant, is indicated by *to-mi-do.* I have elsewhere shown that the designating of chords by the numbers now used is very objectionable, since the figure eight does not show that the sound indicated is similar to the first sound. Instead of saying the chord of the first, third, fifth, and eighth, it would be more effective to use the syllables *To*, *mi*, *do*, *to.* The whole series of syllables in the reformed solfeggio is *to*, *re*, *mi*, *fa*, *do*, *la*, *si.* These syllables have another significance in modulation: the dominant, from the Latin *dominus*, is the master of the next key in a progression by sharps; and in like manner the sub-dominant, *fa*, becomes the father of the next key in progression by flats. Thus it is easy to remember how the new sounds are generated which belong to each new tonic, *do* introducing new sharps, and *fa* new flats. Another remarkable advantage is, that we may always remember, by mnemonic aid, which note designates the relative minor tonic, by associating the term "lachrymose" with the mode or key adapted to mournful subjects; thus, *la* is always the tonic of the lachrymose or minor key. We might go a step further, and give a meaning to the remaining two syllables, by designating the super-tonic *re* as the related dominant — that is, the dominant of the dominant; and *si* as the serial note or the last sound of the diatonic series.

The advantage of associating these syllables with the chords belonging to a given melody is, that the student gradually, and without effort, becomes familiar with the essential conditions and laws of harmony. For instance, knowing that *mi* and *si* indicate the position of the semi-tone intervals, which is an essential part of the minor third, it is easy to find that the four, and only, minor thirds of the diatonic scale are each measured by a tone and semi-tone; thus, *la-si-to*, *si-to-re*, *re-mi-fa*, and *mi-fa-do*, that is to say, the four minor thirds, are *la-to*, *si-re*, *re-fa*, and *mi-do*. As the semi-tone intervals are excluded from the major thirds, there can be only three major thirds in the diatonic scale, to wit, *to-mi*, *fa-la*, and *do-si*. In like manner, the common major triad being made up of a major and a minor third, there can be but two such triads in the diatonic scale, namely, *to-mi-do* and *fa-la-to*.

Without entering further into the domain of harmony, I will conclude by asking the earnest co-operation of every advanced musician in carrying out a reform which will furnish a series of syllables very easily learned and sung, and which gives to the solfeggio a new and valuable scientific significance. A prominent savant lately wondered why so simple and important a reform was not carried out at once by the musical world; but he little knew that artists, who bring their instruments and voices into perfect accord, are not more apt than other people to bring their minds into perfectly harmonious relations, and that discord among them is a more serious matter than among those of less delicate and sensitive organizations. I shall be content if the reform now proposed meet, at present, only the approbation of the chosen few who are always the harbingers of a better day.

In conclusion, Professor Tillman offered the following:

"*Resolved*, That this convention approves of the plan of substituting *do* for *sol*, and *to* for *do* or *ut*, in the solfeggio syllables, so as to secure for each syllable a vowel termination, and to give to the most prominent syllables a new significance, by making them indicators of harmonic relations; the whole series now recommended for use being *to*, *re*, *mi*, *fa*, *do*, *la*, *si*."

This resolution drew forth an interesting discussion, but the mover did not press its passage without mature deliberation, and the congress took no definite action on the subject.

COMPRESSED AIR AS A MOTOR.

The consideration of the subject of the transmission of power by means of compressed air was resumed.

The chairman regarded the subject as the most important that had come before the association for a long time, the use of compressed air derived from waste power, being undoubtedly destined to work a revolution in some of the arts.

Mr. Horace H. Day stated results of his experiments at Bloomingdale, N. J., assisted by Mr. Henson, a mechanical and consulting engineer, during the last summer. No one could long be engaged in such experiments without discovering the absolute necessity of employing some means to absorb or overcome the heat evolved in the condensation of the air. The means he had employed was injecting a small steady stream or spray of water into the air in the cylinder which is undergoing compression Another point, long overlooked, is the necessity of closing up the end of the pipe in the first place. For the want of this simple precaution, as stated by the president on the last evening, many of the early experiments had failed. Gen. Serrell, who has for two years been engaged in the construction of the Hoosac tunnel in Massachusetts, where compressed air is employed, states that he was associated with Prof. Morse at the time that Prof. Morse undertook to connect Washington and Baltimore by a lead pipe, but that after they had carried the pipe two miles from Washington they had failed to get force enough in the pipe to blow out a candle. Had Prof. Morse closed up the end of the pipe until the pressure had accumulated through the whole length of the pipe, he would then have found the force of the air nearly as great, two miles from Washington, as where the air was put into the pipe, and that force could have been maintained by pumping in the air as fast as it was used up at the other end. These are the A B Cs of the question; but, simple as they are, it has cost much trouble and expense to arrive at them. The theory that the whole force of the air is passing like a piston rod, rubbing against the sides of the cylinders, cannot be true, but it must be that the air rolls upon itself, the pressure being lateral as well as longitudinal, the friction being ascertained to be so small as to surprise all who have investigated the subject. We, in America, who have such a vast measure of water power, may well thank France and Italy for the benefits to be derived from the Mount Cenis tunnel, not so much by its facilitating intercommunication between northern Europe and the Mediterranean, as by its successful demonstration of the fact that power can be transmitted through long distances with but little loss by friction, and thus, by the inauguration of a new era in the mechanical world, we have already followed the example of Italy and France. Massachusetts, through its Legislature, after obtaining a report from a commission presided over by Prof. Storrow, upon the system of tunneling employed at Mount Cenis, has adopted the same system, the application of compressed air in its tunneling of the Hoosac mountain; and where Massachusetts leads, in a matter of dollars and cents, it is safe for New York to follow.

Time will prove that this is the best motor ever given to the world, and that the loss of power in its use is the least. Every one admits that there is a great loss by friction even in the best turbine wheel, and in conveying its power to the point where it can be used. Now we shall undoubtedly be able to learn much hereafter with regard to the economical use of compressed air; but I venture to prophesy that, in the present state of the art, we shall be found to utilize at least seventy-five per cent of the power, using it at a distance of two miles from the fall from which we derive our power. All writers on this subject agree that there is a loss by heat evolved in condensation. This is a question, then, inviting our best efforts to devise instrumentalities by which that heat may be saved. Cheap transportation is one of the blessings of the world, and when we can bring the power of Niagara and other falls to the work of tunneling and preparing the way for railway or canal intercommunication, we shall be able to connect, as never before, the waters of New York city with the waters of the great lakes of the west. Another great work needs this aid, the construction of the great canal to connect the Atlantic with the Pacific. We must not stand idle and let other cities take the lead. Already at New Orleans and at Chicago compressed air is in use for propelling street cars.

Mr. J. K. Fisher read an extract from Dr. Barnard's report, read at the last meeting, in relation to the loss of heat. Here is the dilemma in which we appear to be placed: If we work at low pressure, there is a comparatively great loss by friction; and if we work at a high pressure, there is a comparatively great loss of heat from condensation.

Mr. J. Burrows Hyde described the atmospheric railway, invented by an American, and constructed in the neighborhood of London, about the year 1840. They attained a speed of thirty-six miles an hour with a train of cars. Yet they failed, from two causes. At intervals they had engines both for exhaust and for pressure; and it was found that the exhausting engine was more important than the other, for the moment they began to exhaust the atmospheric pressure at the other end began to operate. A trouble arose from the latent heat of the air. Mr. James Nasmyth instituted a series of experiments. He bought from the government dockyard at Woolwich a hydraulic pump, which he took to Manchester and set to work. One day he put a pressure of sixty atmospheres upon it, and the next morning it had gone down to six. At first he thought the pump leaked; but from subsequent experiments became convinced that the pressure passed through the iron in the shape of heat. Coal is gold; in other words, steam is gold. The steam that works the pumps that compress the air is gold. When the air is compressed by steam it costs too much. But what do the waters that tumble down Niagara Falls cost? If those waters can be in any degree availed of for the purpose of compressing air, we have but to do our best to insulate the receivers to prevent the heat from passing through; and that I think is the great secret of this problem.

Mr. Horace Day said that the subject of the loss of power by its oozing through metals in the form of heat, was rather a theoretical question for the laboratory than a practical question; and he cited the report of the experiments at the Mont Cenis tunnel, showing the loss to be too small to be necessarily taken into account. On one occasion they left the air compressed in the pipes for twenty-four days, and during that time the loss was but 1-160th part of a day's supply. The question of the use of compressed air goes farther than furnishing power for elevators or machine shops. It furnishes means of additional convenience and comfort in the private house. It furnishes improved means for light and cooking, for ventilation of a sick room, for cooling the house in warm weather, and will be found useful in numerous other ways when engineering skill and invention shall be brought to bear on this subject.

Mr. Hyde.—But in proportion to the augmentation of pressure, there is a loss from the heat evolved in the condensation and passing through the medium that confines the air. Where the pressure costs so little, as in the plan submitted by Mr. Day, this loss has no commercial value. But if you have to create, by expensive mechanical power, the compression of the air, in order to obtain a valuable mechanical equivalent afterward, there is a loss which must be taken into the account.

Mr. Charles B. Boyle cited the facts asserted by Sir Chas. Lyell, that the South American glaciers come 23° nearer the equator on the south than on the north, attributing the difference to evaporation, as a reason for presuming that there would be less loss from cooling when the compressed air is employed, as proposed by Mr Day.

Dr. Boynton.—At Niagara Falls you have a power which has been unused for many thousand years; and you use a small part of that power to compress air in a cylinder. Fresh air is all the time pressed in behind it; and I ask if it is not cooling in the pipe all the way to Buffalo. And when the air is taken from the pipe at Buffalo to drive machinery, the air in expanding absorbs from the atmosphere a quantity of heat exactly equal to the quantity radiated when it was compressed. Visiting the East river bridge caisson to-day, I found the temperature outside a little below 30°. In the caisson I found the temperature to be about 72°. Upon coming up into the lock, at my request, they let the air out very slowly into the open atmosphere allowing the air to expand to double its volume. The diminution of temperature from expanding two atmospheres from one was just 20°, for the thermometer fell to 52°. Now, if you compress the air in a cylinder to one-half its volume, its temperature is increased just 20°. If you add another charge, will it go any lower? I do not believe it will. I believe it will continue 20° higher in the cylinder than in the tube. I do not think it is necessary to take the loss of heat in the compression into account at all, unless you are going to use the power where the air is compressed. All power is from the sun. The power of coal comes from the action of the sunlight upon the leaf of the plants in the age when the coal was deposited. The power in Niagara Falls is just equivalent to the power of the sun-light which evaporated the water from the ocean and carried it up to the great lakes from which it rushes over Niagara Falls. If we were to heat the air at Buffalo by these 20° its expansive force would be increased; but it is unnecessary to do that.

Mr. C. Edwards Lester.—The statement that so much power has been wasted for many ages at Niagara Falls suggested to me the calculation how much is wasting every day at Hell Gate. There is more water-power wasted in the rivers of every State in the Union than is used by the whole United States. The power of the tide running to waste upon the coast of the United States is greater than the whole mechanical world is using to-day. We cannot much longer afford to incur the monstrous expense of coal in generating steam. There is no necessity for it. Coal will be of less value to us when we learn to make use of the mightier power in the water and in the air, the only two materials God has given us enough of without our taxing our ingenuity and toiling in constant labor to make up the deficit.

The Chairman stated that Mr. Robert L. Stevens, of Hoboken, had early applied air to the bottom of a boat to diminish friction, he had himself independently experimented with air for a different purpose. In the year 1850 or thereabout, he made a cylinder of a single sheet of Russia iron, the two heads of the cylinder were made of wood, in which were the valves; the piston was of wood, packed with leather and connected with two rods, one passing through the center of each head; on each rod was a cross-bar or handle, so that two men could operate this rude air pump. It was placed on a small flat-bottomed boat. The air was forced out through a tin mouth open about a quarter of an inch, and extended entirely across the bottom and near the stern of the boat. The water was forced back at every stroke of the piston, and closed again under the boat. The boat was launched on the Seneca river at Seneca Falls. He tried the experiment, and went across the river at a pretty good speed, but was inclined to think a pair of oars would have been of more service. The difficulty was that the air was too elastic, and the power expended in compressing it was wasted to a great extent.

In some places the use of compressed air would be entirely futile, and in others of great importance. At the Mont Cenis and the Hoosac tunnels its value is demonstrated. Mr. Day has purchased the lower fall at Rochester. It is perfectly feasible to transfer a large portion of that power to the city of Rochester. Nobody pretends that he would get the full amount of the power. If he can get fifty per cent of it, that would be worth a million dollars a year. With regard to taking to Buffalo the power of Niagara Falls, I have always thought there ought to be use for it at Niagara Falls; but if there is not, it can be taken, but not economically, to Buffalo. So far as we can use the water power now useless, we shall economize in coal.

Mr. J. B. Hyde described a mode employed in the west for obtaining power from the force of currents of freely running water.

Mr. W. S. Henson.—In regard to the loss of heat, if we pump heat into the receiver along with the air, of course that heat will radiate and be lost. But you will find it recorded that in the operations at Bardonneche, the Italians lay still for five or six weeks, and only lost about as much air as they could pump in in a quarter of a minute. I think that is a sufficient answer to the suggestion of loss while the receivers are standing still, for in that case they were under pressure the whole time.

Mr. Day.—I have figured up the cost at Rochester, for the land, the power, the pipes, and all the apparatus, and I cannot make it reach $40,000, including the expense of managing the company. I was told, a few days ago, that the cost of running a millstone at Rochester, requiring twelve and a half horse power, is $1,000 per annum, making a cost of $80 per horse power. When I say that I can carry the power from the lower fall, and make as big dividends as the railroads when fairly conducted, ordinarily make for $12.50 per annum for each horse power; I think it will show that this is not only good in theory, but has money in it.

Dr. J. F. Boynton.—There is one point that strikes my mind with regard to working compressed air expansively, as you would steam. Now if we take a cylinder and divide it into seven parts, corresponding to a pressure of seven atmospheres (the pressure at Niagara being about six atmospheres), then the air in one of these divisions will expand to fill the whole cylinder. I do not think you will have a loss of seven times 20°, but only a loss of 20°.

Mr. J. K. Fisher.—I do not deny the economy of Mr. Day's system in using a power which is running to waste, for if we were to realize one-fourth of the power it would be a profitable thing.

The President announced the continuation of this subject at the next meeting.

Adjourned until January 12, 1871.

January 12, 1871.

Prof. S. D. Tillman in the chair; Robert Weir, Esq., Secretary.

Mr. Pratt exhibited an improved pivot for balanced sashes employed, especially in hotels, for ventilation, over chamber doors. The pivot is divided, and the elasticity creates sufficient friction to keep the sash in any desired position, in any ordinary current of air.

Mr. David P. Corry exhibited a model of an improved automatic car coupling.

Compressed Air as a Motor.

The Chairman said: Dr. John Gorrie, of Apalachicola, gave in the *American Journal of Science and Arts*, in 1850, a very full account of experiments made by him at New Orleans, for the purpose of ascertaining the quantity of heat evolved from air by mechanical compression, and presented the results of each series of experiments in tables so arranged that a simple inspection of their columns disproves the deductions of Dalton and Leslie, that the evolution of heat from air was directly as the reduction of its volume. He says: "In the experiments, as recorded, all preconceived notions of a uniform law of progression of any kind were set aside, and nothing is regarded but the quantity and tension of the materials employed, and the indication of the thermometer. The experiments, indeed, show that if there is any precise law of progression, or fixed relation between an increase of tension and the amount of heat set free in air by it, it must be in inverse and rapidly diminishing ratio. Thus, the quantity of heat generated by compressing air to half its volume is, as shown, sufficient to elevate the temperature of an equal weight of water 74° Fahrenheit, and of its own body 277°. When it was reduced to one-fourth of its volume, the increase of heat became for water 105° Fahrenheit, and for air 395° Fahrenheit; and when condensed to one-eighth of its original volume, the heat was for water 125° Fahrenheit, and for air 472° Fahrenheit.

According to these observations and deductions, while the density of air increased in the geometrical progression 2, 4, 8, the heat evolved corresponded, nearly, to the arithmetical series 3, 4, 5. But the ratio in the differences of temperature between the assigned densities followed a very different rate of progression from either; thus, for the densities 2, 4, 8, atmospheric pressures, the corresponding differences of heat evolved were in the decreasing numbers 277, 118, 80, nearly as 3.5 : 1.5 : 1

He admits that more reliable philosophical instruments and still more extended series of observations only will justify the attempt to establish a natural law from these deductions; yet, notwithstanding the imperfection of the instruments and machinery used, he believes they cannot be in error to any considerable extent, and does not hesitate to commend them to public confidence.

Prof. P. H. Vanderweyde.—Joule made a great many experiments, much more perfect in their character, for the same purpose; and it is surprising that Dr. Gorrie knew nothing about them. His object was to determine the mechanical equivalent of heat. Experiments were made by scientists in 1830, by which they found that the temperature increased at a less rate than the compression. But their experiments are considered of no permanent value, because they omitted to take into account the heat of the vessels in which the compression took place. Joule corrected that. He surrounded the compressing vessels with a known volume of water at a known temperature. Upon compressing the air, the amount of heat evolved was manifest. But corrections were necessary, because the heat produced was not due altogether to the compression of the air. First there was the friction of the pump, and then the friction from stirring the water. In order to determine what correction to make, he moved the piston and stirred the water in the same manner without compressing the air, and observed the amount of heat evolved; which, being subtracted from the former amount, left the amount due solely to compression. In that way he determined with great accuracy the increase of temperature corresponding to any compression, which is well known as the mechanical equivalent of heat, the relation between the foot-pound and the temperature. Dr. Gorrie did not know of these experiments, and the reason his results were different was simply that he did not take into account the cooling of the air in the vessels in which it was inclosed. The specific heat of air is very small, being only one-fourth of that of the same weight of water, and only 1-3200th part of that of the same volume of water. A cubic inch of iron will absorb as much heat as nearly 4,000 cubic inches of air. It is therefore exceedingly difficult to make these experiments, and absolutely necessary to allow for the heat of the containing vessel.

The Chairman.—Joule merely demonstrated by experiments, which lasted eight years, that the mechanical equivalent of heat first announced by Meyer was correct.

J. F. Haskins, the Superintendent of the Burleigh Rock Drill Company, the manufacturers of the air compressor used in the Hoosac Tunnel, spoke as follows:

Mr. President and Gentlemen.—I was advised a few days since, by mail, by an old friend, that he had made an appointment with you for me to lecture before your association this evening. You will remember, sir, that I at once wrote you, that lecture I could not, but gladly would I meet you and your friends, and add what I could to the limited information extant upon the subject of compressed air. I am perhaps as familiar as the most practical mechanical engineers with the subject. From long connection with it, my experience has been varied in both cold and hot compressed air, and to-day I regard them as the coming enigma or mechanical nut to be solved and cracked. I use the phrase "mechanical" literally, for science seems all at variance. Well do I remember reading the story of the large blast pipe erected in England to convey air from one set of blowing engines to two stacks some distance apart, as I remember it. They built the air conduit of brick and metal, with sundry turns and crooks. On starting the engines, they got no air through the long pipe; fault was found with the constructor. He insisted that there was a hole through, and to prove it, he put in a cat. She came through almost immediately; but they never could get any blast through. To-day the reason is obvious, and we will come to it shortly.

The student, in searching for information on this subject, is met at once, by that stern law as to the resistance of the flow of air in pipes, and judging from the numerous queer questions we who are in the trade have to answer, one would conclude that they never go beyond this meeting. The law runs:

"The resistance increases as the square of the velocity, and is further augmented as the square of the quantity."

You will smile when I tell you that this is both true and false. True as they determined it, and false as air is to-day conveyed and handled. The practice of to-day carries at Mount Cenis air at fifty, sixty, and seventy pounds to the square inch four miles in pipes of eight and ten inches diameter, and under my own eye, at Hoosac tunnel, Massachusetts, we are daily carrying air at sixty and sixty-five pounds one and three-quarter miles with little or no loss. Nor are either of the above the first or only instances of long conducts. They are numerous and in pipes from one inch to eight, nine, and ten inches. In the business in which I am, and have been engaged for some years, that of designing, building and operating air-compressors and rock-drills, we are frequently called upon to carry air at high pressures long distances, and we daily meet instances where it would be impossible to do so, were the above law true. This is one of the numerous instances wherein practice is always of value, and it is to give you, sir, and the world the benefit of some of that practice that I am here to-night, and I shall esteem it a pleasure to reply to any questions which any may have to ask.

My first connection with the subject dates back to 1858, when, as foreman of an establishment in Massachusetts, I entered upon the manufacture of Ericsson's, caloric engines, air-compressing pumps, and machinery to be run by them. So to that well-known engineer, John Ericsson, I was indebted for my first knowledge on the subject, and first opportunity to gain further information; and I do not hesitate to say that had he been left entirely untrammeled by others patenting modifications of his great discoveries, the world would to-day be using a large per centage of compressed air where steam is now used. It is a very unfortunate fact, but fact it is, that this interference locked up an immense amount of information which will see the light but gradually. Just now, we find parties almost daily inquiring if they can convey air various distances, and run machinery with it. Most certainly you can, and that economically too. There are numerous instances on record where it was done long years ago, and to-day I can point to very many places where it is being done daily, and creates no wonderment.

In this city of New York, many years ago, came a clothing firm to Capt. Ericsson for relief, in the way of power to run sewing machines. The relief was readily furnished, and a caloric engine in the cellar compressed the air ; it was carried to the upper story in pipes, and there moved little engines, which, in turn, operated sewing machines to the number of some eighty. And this was not all, the act of compressing air throws off its heat, and then when it is again exhausted, it of course takes up that heat again from the surrounding atmosphere, doing two things, condensing and precipitating the vitiated air, and furnishing one of the best possible means of ventilation.

These machines worked successfully for years, and were only stopped when business lagged. This was in 1858 or 1859, and yet, were it to be repeated to-day, every New York daily would contain double-leaded articles on the subject, and the world would be astonished. About 1853 or 1854, at Glasgow, Scotland, there was built, from the designs of Mr. David Elder, an air-compressing engine, known as "Randolph's Air Pressure Engine." This engine compressed air to 20° and 30°. It was then conveyed down to the lower level of the mine, and there actuated an engine, similar to a steam engine, to do the needed pumping. It ran for years, successfully and economically, and yet the world has never known it. It is being done to-day, in various places, using ordinary pumps; but, as the world moves, this plan is now to be superseded by a much simpler plan, compressed air still being the motor, but without the intervention of an engine. We will speak more of this, further on.

Now, were the above law literally true always, I fear some of these things might not be accomplished. Within a year there has been a great deal said and written as to the *possibility* of running street cars by means of compressed air. Any one might have learned, upon inquiry, that such a thing was not only possible, but that it had been done, on a small scale, a dozen years ago. I, jointly with a friend, filed a caveat, in 1858, at the patent office, after a series of successful experiments, extending over some months, for doing so ; and to-day cars are running so driven, and there is not the slightest reason why they should not be. We might go on, almost indefinitely, multiplying instances of different things which have been done years ago by compressed air, and which are just now coming up again; this time, I trust, to be generally adopted for the good of the world at large. I am in my daily practice often reminded of him who was once told he "could not do a given thing." His reply was: "But I have done it." And so I often find myself amused in this direction by those who "wonder if a given thing can be done."

George Stevenson was instructed by his backers not to say to parliament that he could build a locomotive which could be made to run thirty miles per hour, for fear of defeat. I am in much the same condition, for I dare not tell all I know or believe on the subject, for fear of disbelief. And yet, let me say to you, sir, that, if you pursue the study of the subject, you will be astonished at the amount which has been and is being done in this direction; and I know of no more agreeable pastime than the chasing up of this matter. Whenever the subject of compressed air is mentioned in American papers, the Mount Cenis tunnel comes in for a large share of the article; and yet, within 200 miles of this city, the Hoosac mountain is being daily pierced at either end about five feet, by means of the Burleigh rock drills, using compressed air as a motor. Near Mauch Chunk, Pennsylvania, 100 miles from here, a railroad tunnel is being driven under a mountain by the same agency. There are numerous other places where the same is being done; and yet how few of the people know anything about it. Your own East River bridge — the lamented John A. Roebling's last and greatest work — could not be constructed on that plan but for compressed air. To the westward, at St. Louis, we find Col. Eades erecting an immense bridge, and sinking his piers by means of this same subtle agency — for subtle it is, the law to the contrary notwithstanding. These are on the caisson-sinking principle; while east and west they are driving piles for piers by compressed air, and, were I at liberty to make use of the information, I might add several other uses to which it will ere long be applied.

We have seen, then, that the power of compressed air is a reality; and now a little of its production; and here let me say, that we can, of necessity, touch but lightly on any one's plan, as they are many, and yet there are but few which are really of utility, or are commercial successes. They may be named as within three classes: "The water column;" "the piston immersed in water;" and "the piston simply packed and lubricated by water or other fluids."

Of the first class there are several varieties; all, so far as my knowledge extends, have in them elements of success. They operate upon the general plan of starting and stopping a column of water. Those at Mount Cenis have been very successful and economical. They have small engines actuated by compressed air, which operate the induction and eduction valves. They are placed at an inclination, drawing their supply of water from cisterns, thus insuring clean water. With them they compress air to sixty and seventy pounds to the inch, and sometimes more, as they may require. Other apparatus, depending on a column of water for its power, has been constructed, and there are several parties now experimenting in that direction. It is a grand field, open to, and inviting, the attention of the mechanical world; and few fields offer greater inducements.

Of the immersed class of compressors, there are also several. They do well for low pressures, but not as well for high ones, the difficulty being that the piston, in moving, has also to move a large body of water, which, of course, absorbs an amount of power equal to its own inertia. The names of Ericsson, Somellier, Doane, Butler, Burleigh, Spear, and Haskins, appear as inventors of the last class, and among them they have indeed produced some queer machines, and surmounted what in years past were considered almost insurmountable obstacles.

We come now to the transmission. In my judgment (and I speak from experience) there is not the slightest difficulty in doing so. I regard the proposition of Mr. Day, to harness the lower Genesee Falls and convey its power to Rochester, as more than feasible. It is only necessary to have the conduits large enough. I should not hesitate to stake what little reputation I have on a successful result, and I think we have seen above that there are instances enough of success to refer to, to warrant such a declaration. Once success is demonstrated there, how many other similar spots can be found to apply the apparatus to! Think of the immense number of uses to which the compressed air can be put, when it can be had by turning a stop-cock in each house, as you now turn on and off your gas.

Mr. Robert Spear, of Portland, Me., has invented numerous devices in connection with compressed air. Among them a pump, for use in very many places, as mines, deep shafts, houses, and other places where steam will not answer. It has a great deal of merit, and furnishes a means, long needed, of doing the class of work above mentioned. So almost daily inventors are aiding the great cause, each by his little addition to the general whole; and let us join that progressive party and aid the onward march for more air, and that compressed, to turn, spin, weave, print, carry, cut, mend, break, warm, cool, propel, and stop for us; until it shall do safer and better for us what steam now does, and many things which it cannot do, not forgetting that very important matter of ventilation.

Mr. Haskins illustrated upon the black-board the construction of the machinery in use at the Hoosac tunnel, and, in reply to inquiries, made the following additional statements:

The air being compressed in a cylinder of 14¾ inches diameter, and fifteen inch stroke, running ninety strokes per minute, is cooled by introducing a spray at each stroke consisting of two gills of water, being discharged at an advance of about forty degrees Fahrenheit.

The power applied is from forty to sixty horse power. The power actually used is about eight horse power. It was desired to have a large surplus of power, and the air not needed for power is used, and very important for ventilation. The company sell their best form of air compressors under the guaranty that they shall give back seventy-five per cent of the power expended; and their estimate was, that but nineteen per cent is lost under proper management.

The apparatus is so arranged that in the revolution of the crank of the steam engine the position of greatest power shall correspond with the close of the motion of the condensing piston, where there is the greatest resistance. As little space as possible is left in the condensing cylinder for air, which will be expanded again upon the retreat of the piston. The thickness of writing paper is all the space usually left.

The power had been shown by indicator cards; but it was no easy matter to determine the exact amount of power while the machine was striking 300 to 400 blows per minute. He had, therefore, no means of determining with accuracy the proportion of the power actually lost in the works at the Hoosac tunnel.

The pamphlet published by the Burleigh Rock Drill Company, contains a table showing the result of experiments made at Hoosac tunnel, the air being carried 7,150 feet through eight inch iron pipe, giving the difference in pressure at the compressors and at the heading of the tunnel; but that table was unreliable. They had succeeded in getting cards varying about one and three-fourths pounds, with either a four-inch cock open at the other end, or the drills running. On the average, as the pressure increases, the difference decreases.

Horace H. Day corroborated by his own experiments, the estimate of Mr. Haskins, that nineteen per cent only of the applied power would be lost.

Prof. Vanderweyde.—The amount of loss from the use of compressed air depends upon principles which are pretty well settled. There is no doubt that there is a loss by the heat evolved. Wherever you generate heat you lose power, and Dr. Bonaire points out exactly how much. We can predict what expansion of air will be produced in heating air; and by reversing the process, we can predict what amount of heat we shall get by compressing the air. We know that air doubles its volume when we heat it 480° Fahrenheit. But when we keep the volume the same, and double its pressure, we do not require so much heat. There is a distinction between heating air to a certain pressure, and heating it to a certain volume. When we heat air, and use the air to lift a piston and perform labor, we lose a certain amount, and that amount is what we lose in machinery which compresses air. It is an error to suppose that when the air is employed to do work, the lost heat will be returned. It is an error to calculate the foot-pounds required to compress air into a cylinder, as the power to be obtained from that compressed air. When we lift a weight we do not produce heat; and when the weight comes down we get all the power back. But when we generate heat we lose power. We cannot possibly compress air without producing a certain amount of heat. And it appears from the experiments of Joule, that the greater the compression the more heat we lose.

Were the experiments of Joule to be repeated, we might improve upon them; for we could determine how much ice is melted during the compression; but I have no doubt that the experiments, whenever proper care is taken, will confirm the principles already laid down.

There is an advantage, which it may be interesting to mention, in using a gas which may be liquefied. In the use of compressed air, the more air we put in, the greater the pressure. But if we use a gas which liquefies at a pressure of eight atmospheres, we may continue to introduce that gas, and it will be liquefied without increasing the pressure, until we shall have stored up an amount capable of keeping up that pressure, which, if restored to the form of a gas, would produce a pressure equivalent to 800 atmospheres.

Carbonic acid gas may be liquefied, and has been used in that way, and it worked very well for a short time, but it soon became so cooled that it was necessary to stop the engine until heat could be absorbed.

Ammonia is liquefied at much less pressure than carbonic acid gas. Another advantage of ammonia is the great rapidity with which it is absorbed by water. When the ammonia has been expanded and done its work, it is discharged into water, which absorbs it, and becomes heated. That heat is utilized in the heating of the liquefied ammonia, and the water is thus kept cool and ready to absorb the ammonia.

But for stationary engines there is no more valuable engine than that employing compressed air, and it has the advantage of giving ventilation. I believe the gentleman will agree with me that the Hoosac tunnel would have been entirely impossible to construct if it had not been for the use of compressed air for the double purpose of ventilation and driving the machinery.

Mr. Haskins.—Certainly. I think so.

Mr. J. K. Fisher suggested the employment of hydrogen gas, to be compressed, and after its use for power, to be burned to heat the gas on its way to the engine.

The Chairman remarked that coal gas would answer the same purpose and be less expensive. Neither hydrogen nor coal gas has been liquefied.

Horace H. Day.—Among the most interesting points made by Mr. Haskins was the announcement that two gills of water was sufficient to keep the air cool. I will ask him, if his experience will enable him to answer, suppose the whole volume of the water comes upon the air to be compressed, so that the air passes from the compressor without being heated, is there any loss of power from the heat, or is the air really heated?

Prof. Vanderweyde.—The compression of the air heats the water. If there are but two gills the amount is easily perceived. If there is a larger amount of water the same heat is lost, although not so readily perceptible. Two gills, heated forty degrees, is about equivalent to a whole unit of heat. But that is not all. When air is compressed its capacity for taking up moisture increases, and in addition to the water heated forty degrees there is a portion of it which becomes vapor, absorbing 1,000 degrees of heat. When we compare the amount of heat with the quantity of air to be cooled, which has so little capacity for heat, this result is not surprising.

The Chairman.—We should not estimate the value of compressed air altogether upon the basis of the amount of power lost. Suppose there is a loss of twenty-five or even fifty per cent; that is a mere bagatelle, compared with the uses to which air can be put by means of waste power. This discussion has been chiefly in view of the importance of utilizing waste water power, which is one of the most important problems ever presented before this association.

Prof. Vanderweyde.—Suppose three-fourths of the power of Niagara Falls should be wasted. The remaining fourth would be a blessing to the city of Buffalo.

The Chairman expressed some doubt as to the feasibility of carrying compressed air from Niagara to Buffalo; the expansion and contraction of the tube must be provided for, and he inquired of Mr. Day how he proposed to make his air tube tight.

Mr. Day.—We shall have slip-joints, but expect to avoid the expansion and contraction mainly by putting it under ground. It should also be lined throughout with a suitable varnish.

The Chairman referred to Spear's new pipes, in which the friction of the air against the inside of the pipe is claimed to be lessened by inserting, at short intervals, thin rings fitted to the bore of the pipe so as to prevent any motion of the air nearest to the pipe. This plan he regarded as unphilosophical. If contracting the pipe at intervals was of any value the contracted places might be multiplied until the pipe became wholly of the reduced diameter.

Mr. Robert Weir said that the contractions appeared to him a poor substitute for an air chamber.

Prof. Vanderweyde said that at the time the water was let into the pipes at Chicago, those who watched for its coming had to wait an hour and a quarter for the air to come out, and when the water came at last it came in a shallow stream of dirty water, running over the floor, but gradually rose.

Before the adjournment it was proposed to introduce a resolution embodying the opinion of the Club upon the subject. The Chairman remarked that it was contrary to the present custom of the association to express by motion any opinion upon a subject presented for discussion. He thought, however, that a general opinion of the great value of this method of transmitting power was prevalent with the members.

Adjourned.

January 19, 1871.

Prof. S. D. TILLMAN in the chair; ROBERT WEIR, Esq., Secretary.

The Chairman presented the following items of scientific news:

TIERS ARGENT.

This alloy, generally supposed to consist of one-third silver and two-thirds nickel, has been analyzed recently by Dr. C. Winkle, and found to be composed of silver, 27.56 parts; zinc, 9.57; nickel, 3.42; copper, 59.06; total, 99.61.

THE WATER-HAMMER MADE LUMINOUS.

Prof. Lommel has made a series of experiments which prove that the water-hammer, consisting of a glass tube and bulb partly filled with water, which had been freed from air by long-continued boiling, when electrified in the same manner as the Geissler tubes, containing a rarified gas, is affected like such tubes, and exhibits brilliant luminous phenomena.

Dr. L. Bradley remarked that this served to show that vapor of water, in an attenuated condition, conducted electricity in the same manner as the gases.

PROPOSED SHIP CANAL IN ENGLAND.

A plan for shortening the sea passage between the Bristol and English channels, by the construction of a ship canal across the counties of Somerset and Devon, has been approved by prominent engineers, and is about to be brought before the public authorities for their sanction. The length of this canal is to be fifty-nine miles, its width at the surface 124 feet, at the bottom thirty-one feet, with a depth of twenty-one feet. This would allow all vessels of moderate draught to pass through from sea to sea. Such a canal would doubtless be of immense advantage to the coal traffic of Wales.

FUSION OF IRIDOSMINE.

Mr. M. G. Farmer, of Boston, has succeeded in fusing iridosmine by a current of voltaic electricity from sixty large Bunsen cells. Grains of the mineral were placed in a groove made in charcoal, each end of which was connected with a large platinum wire. The temperature of fusion was estimated at about 10,000 degrees Fahrenheit. His object was to obtain a pure alloy of iridium and osmium, to be used in electric illumination. On bringing one square inch of the alloy to near the fusing point, by means of an electric current, he found the light emanating from its surface equal to 2,800 candles. This new light threw shadows at mid-day, and had sufficient actinic power to produce excellent photographs.

Dr. L. Feuchtwanger said of this substance, that it was exceedingly difficult to melt. He had made some attempts in this direction with the compound blow-pipe, but had not succeeded in obtaining a perfect fusion.

Rain.

Mr. James Glassier, F. R. S., of England, in a recent lecture, said that the whole of the rain had its origin and fall 800 feet from the earth. Desiring to discover the influence of the moon on the elements, he found, after a long series of investigations, that on the ninth day of the moon there was much more rain than on any other day, and that on the first and last week of the moon there was the least amount. He had taken account, from 1815 to 1863, of every day on which there had been an inch of rainfall, and he had found that on July 26, 1867, the rainfall amounted to three and seven-tenths inches, the largest amount that had fallen in one day at the Royal Observatory. From careful observations made by him, he had no doubt that the moon did exercise an influence upon rain. Another of his investigations was as to the time of day that rain fell most, and he had found that the largest quantity fell at about four in the afternoon.

Dr. Bradley said he thought that the greatest amount of rain in our country fell in the afternoon, and thought that it would coincide with the time of the greatest number of thunder showers. He held the opinion that rain formed at all heights, and adduced the formation of hail as a proof.

Quantity of Carbonic Acid Gas Contained in the Air of School-Rooms.

From the *Amerikanische Schulzeitung*, we learn that Dr. Breiting, of Basle (Switzerland), has examined the air in the school-rooms of that city. As one of the results of his examination, we give the analysis below of the air taken in a room measuring 251.61 cubic meters, having 10.54 square meters of windows and doors, and containing on the day of examination fifty-four children:

Time.		Quantity of Carbonic Acid Gas.		
7.45 A. M.,	before the commencement of school,	2.21	parts pr	10.000
8 A. M.,	end of first recitation	4.30	"	"
9 A. M.,	after the recess	4.07	"	"
10 A. M.,	before a brief recess	6.87	"	"
10.10 A. M.,	after the recess	6.23	"	"
11 A. M.,	end of the recitation hour	8.41	"	"
11.10 A. M.,	the room being empty	7.30	"	"
1.45 P. M.,	before the commencement of school,	5.08	"	"
2 P. M.,	beginning of recess	7.66	"	"
3 P. M.,	after the recess	6.46	"	"
4 P. M.,	end of singing lesson	9.36	"	"
4.10 P. M.,	the room being empty	5.72	"	"

A New Disinfectant.

The hydrated chloride of aluminum, long known to chemists, has lately been extensively used as a disinfecting agent. It is readily made by dissolving alumina in hydrochloric acid. The solution on evaporation leaves crystals of what was formerly called the sesquichloride of aluminum in combination with three molecules of water. The atomic weight of aluminum having been doubled by agreement of advanced chemists, the sesquichloride becomes the trichloride of aluminum. The hydrated compound has all the virtues of the chloride of zinc without any of its dangerous qualities. It arrests decomposition and destroys disease germs, and still is not injurious or dangerous when applied as a wash for the body, or a gargle in cases of sore throat, diphtheria, whooping-cough, or scarlet fever. It has a sweetish astringent or aluminous taste. Its virtues are derived from the chlorine contained in it, being more highly charged with that element than common salt. It has been successfully used as an antiseptic and in the preservation of food.

The following paper was then read:

THE ACTION OF THE RECIPROCATING PARTS OF STEAM ENGINES, AND ITS INFLUENCE ON THE PROBLEM OF HIGH PISTON SPEED.

By Charles T. Porter.

Your attention is invited to a proposition which, on its bare statement, will probably strike many persons as absurd. It is, that a reciprocating engine is, with respect to the line of centers, identical with a rotary engine; reciprocation is, in the line of motion, identical with rotation; the reciprocating parts of an engine, at the instant when the direction of their motion is reversed, exert a force which is precisely the same centrifugal force that would be exerted by them continually if they were revolving with the crank, so that reciprocation may properly be defined to be rotation in a straight line.

I am well aware that the doctrine that the reciprocating parts of an engine exert a force on the dead centers, where they are at rest, when their motion in one direction has ceased, and that in the opposite one has not yet begun, is rank heresy; as much so as was once the assertion that the earth revolves on its axis. It is, however, equally true; the demonstration of it is quite simple, and I do not doubt that at every step I shall have your entire and cordial concurrence. If we find ourselves on ground not before trodden, we shall nevertheless be sure that it is firm and solid ground. It should be observed here, that the action which we are to investigate has no *necessary* connection with high piston speed. Although it is what makes rapid speed practicable, and although a correct understanding of it wholly removes any theoretical objection to the employment of such speed, still it takes place at all speeds, varying only in the amount of centrifugal force developed, according to the law of central forces, namely, directly as the mass, directly as the diameter of the circle when the number of revolutions is constant, inversely as this diameter when the velocity is constant, and as the square of the speed in a given circle. The motion of a piston controlled by a crank, we know, is not uniform; but commencing from a state of rest, it becomes at the mid-stroke slightly in excess of that of the crank pin, and at the termination of the stroke has been reduced back to nothing. In giving the piston speed of an engine, we always name its mean speed, found by multiplying the length of the stroke in feet into the number of strokes made per minute, but the speed attained at the middle of each stroke is about fifty-seven per cent greater than this, having the same relation to it that the semi-circumference bears to the diameter of a circle.

Let us take for illustration the case of a horizontal engine of sixteen inches diameter of cylinder by thirty inches stroke, the reciprocating parts of which weigh 1,200 pounds, and which makes 122.3 revolutions per minute. The mean piston speed is 611.5 feet per minute, while that reached at the middle of each stroke is 960 feet per minute, or sixteen feet per second.

The first question requiring to be answered is: What is the amount of accelerating force, constantly exerted through a distance of fifteen inches, that is required to impart to a body of 1,200 pounds weight a velocity of sixteen feet per second? We suppose the motion to be without friction, and are inquiring only for the force required to overcome the inertia of the mass. The laws of falling bodies will furnish the answer to our question.

The motion being horizontal, gravity has no effect, either to produce or to destroy it; but a force of 1,200 pounds, equal to the weight of these parts, would, by being constantly exerted horizontally through a distance of 16.083 feet, give to them a velocity of 32.166 feet per second, this being the velocity imparted by gravity to a falling body. But what velocity would this force impart by acting through a distance of 1.25 feet? The velocities acquired by a body accelerated by a constant force vary as the square roots of the distances through which the force acts. Thus a falling body, to acquire a double velocity, must fall through four times the distance; and to acquire a five-fold velocity, it must fall through twenty-five times the distance; and so the force equal to their weight, acting through 1.25 feet, would impart to the reciprocating parts a velocity of 8.968 feet per second,

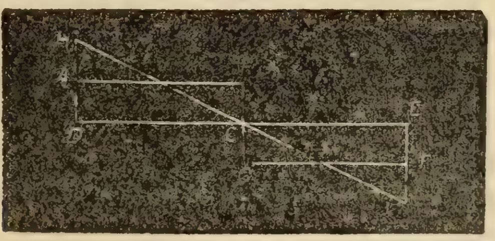
$$\frac{32.166 \times \sqrt{1.25}}{\sqrt{16.083}} = 8.968.$$

But if 1,200 pounds will give a velocity of 8.968 feet per second, what force will be required to impart a velocity of sixteen feet per second? The forces required to impart different velocities by acting through a given distance, must vary as the squares of the velocities imparted. Thus, to give to a body, in moving through a distance of 16.083 feet, a velocity of 64.332 feet per second, or double that which gravity would impart, the accelerating force must be equal to four times its weight; and so the force required to impart to a body of 1,200 pounds weight a velocity of sixteen feet per second, by acting through a distance of 1.25 feet, is 3,820 pounds.

$$\frac{1{,}200 \times 16^2}{8.968^2}$$

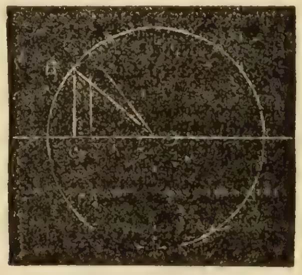
We have thus completed the first step in our demonstration. There can be no doubt that our piston, cross-head and connecting-rod have attained a velocity of sixteen feet per second, that this velocity has been imparted to them in moving through a distance of fifteen inches, and that they must have been accelerated by a force, supposing it to have been exerted constantly, of 3,820 pounds.

But it is obvious that the force accelerating the action of a piston cannot be a constant force, because if it were so, then at the middle of the stroke, where acceleration ends, it must cease abruptly, and retardation must commence in the same manner, as would be illustrated by two parallelograms, A, B, C, D and E, F, G, C, in the accompanying figure. We know very well that, instead of this, acceleration passes at the mid stroke into retardation in a manner wholly insensible?



How shall this mystery be explained? There are various methods, more or less abstruse, of reaching the explanation; but there is one that is exceedingly simple, indeed so much so that it is surprising that engineers are not uniformly familiar with it. It is found by almost the mere inspection of the table of versed lines.

The motion of a piston, disregarding the effect of the angular vibration of the connecting rod, is equal to the versed sine of the angle which the crank forms with the line of centers. The versed sine of any angle shows then the motion of the piston from the commencement of the stroke. If we take the versed sine of any degree, and subtract from it that of the preceding degree, the remainder will represent the motion of the piston while the crank is moving through the last degree. Thus, in the annexed figure, while the crank is traversing the arc A B, the piston is moving through a distance equal to Ac, the versed sine of the angle A D B, and so on.



The following table, which any one can complete, shows, in the first column, the versed sine or total piston motion for the first and last five degrees which the crank passes through while the piston is making a half stroke; and in the second column, obtained by subtraction as above, shows the motion for each of these degrees.

The motion for each succeeding degree of course increases all the way, but in what ratio does it increase? This is the vital question. To answer it, we subtract from the motion for each degree that for the preceding one, and the difference shows the velocity imparted while the crank was moving through the last degree. In this manner we obtain the third column, showing at a glance the velocity imparted to the piston at each degree; and how wonderful is the revelation! The acceleration, at first nearly uniform, diminishes in an increasing ratio, and for the ninetieth degree is less than one-fifty-seventh that for the first degree, and is just equal to the diminution in the acceleration for the eighty-ninth degree, showing how, at the end of this degree, it ceases altogether.

Degrees.	Versed sine or total motion.	Motion during each degree.	Velocity imparted during each degree.	Difference.
1	.0001523	.0001523	.0003046	....
2	.0006092	.0004569	.0003046	0
3	.0013705	.0007613	.0003044	2
4	.0024359	.0010654	.0003041	3
5	.0038052	.0013693	.0003039	2
86	.9302435	.0173992	.0000265	....
87	.9470640	.0174205	.0000213	52
88	.9651005	.0174365	.0000160	53
89	.9825476	.0174471	.0000106	54
90	.1000000	.0174524	.0000053	53

The motion during the first two degrees seems to be uniformly accelerated; but if we should go to a sufficiently high place of decimals, we should find the acceleration absolutely greatest on the very dead center.

It will be interesting to compare this diminishing acceleration with the uniform acceleration of the motion of a falling body. The following table represents the latter, decimals being omitted for convenience, but not at all affecting the table for the purpose of this comparison. The second and third columns are derived from the first by subtraction, in the same manner as above.

Seconds.	Total distance fallen through.	Distance fallen in each second.	Velocity in feet per second imparted during each second.
1	16 feet.	16 feet.	32 feet.
2	64 feet.	48 feet.	32 feet.
3	144 feet.	80 feet.	32 feet.
4	256 feet.	112 feet,	32 feet.
5	400 feet.	144 feet.	32 feet.
6	576 feet.	176 feet.	32 feet.

If, now, at each degree, we draw an ordinate, perpendicular to the line of centers, and of a length proportionate to the acceleration at that degree, we shall find that a straight line connects all their extremities, showing the acceleration to be represented by the right-angled triangle D C H, Fig. 1.

This any one can verify. It is thus revealed to us, that precisely on the dead center the acceleration of the piston's motion is double its mean acceleration, and the force required to produce it is twice that which would be constantly required, or, in the case we are considering, is 7,640 pounds, equal to a pressure of thirty-eight pounds on each square inch of piston area.

This fact is so important, that it may be well to exhibit it also in another manner. We have seen that the motion of the piston is, for the first two degrees, accelerated in a manner which may be regarded as uniform. The distance moved through by a body uniformly accelerated, increases as the square of the time, as is shown in the last table.

If then, we take the co-efficient of the motion for the first degree .0001523, and multiply it by the square of the number of degrees traversed by the crank in one second, we shall have the distance which the reciprocating parts would be moved in one second, at their original rate of acceleration, supposing it to be continued uniform during that time, if the length of the crank equalled 1. This distance is 82.05254 feet, for the crank moves in one second through 734 degrees, and $734^2 \times .0001523 = 82.05254$. The length of the crank is, however, 1.25 feet, so that the distance moved through would be 102.5 feet. This distance, divided by 16.083, gives the quotient 6.37, which is the accelerating force in terms of the weight of the parts. But $1{,}200 \times 6.37 = 7{,}644$, the same result as before.

The second point in our demonstration is now established, that on the dead center, where motion begins to be imparted to the piston, it is imparted in double the average ratio, and the force required for this purpose is just twice as great as a uniform accelerating force would be, to give to it the velocity that it has at the mid stroke.

The retardation of the motion of the piston by the crank, bringing it to rest at the end of the stroke, is the reverse of the acceleration, and is represented by the triangle ECI, figure 1. This to one who has clearly apprehended the acceleration must be sufficiently obvious.

We are arrived now at our final proposition, that the resistance offered by the reciprocating parts of this alternate acceleration and retardation is, at its culminating point, the dead center, precisely the centrifugal force that the same weight could exert continually, if it was revolving with the crank pin.

Let us examine this action in the light that has now been thrown upon it. We will suppose the steam to be suddenly shut off, so that the acceleration, as well as retardation, is effected through the crank. We note, first, this distinction, that while at the mid stroke acceleration passes, when diminished to nothing, into retardation, commencing at nothing, at the centers, on the contrary, retardation passes at its maximum into acceleration at *its* maximum. A closer examination shows, however, that while in the first case the direction of the force changes, in the latter it does not change. This direction must be reversed twice in each revolution, and this reversal takes place at the middle of each stroke, and not on the center. The crank begins at each mid stroke to retard the motion of the piston, and opposes to it a continually increasing resistance, retarding it more and more rapidly up to the center line, at which point it begins, *by a continuance of the same force*, to urge it in the opposite direction. The strain of the piston on the crank, in either direction alternately, begins insensibly at the mid stroke, culminates on the center, and diminishes to nothing at the mid stroke again, and this resistance, at its culminating point, is the centrifugal force which the mass would exert if it were revolving instead of reciprocating, and at every other point is the horizontal component of that force.

This is readily established. First. The direction of the force is radial. Secondly. The co-efficient of centrifugal force is the decimal .000341, which is the centrifugal force, in decimals of a pound, of one pound making one revolution per minute, in a circle of one foot radius. This co-efficient shows the centrifugal force of 1,200 pounds making 122.3 revolutions per minute, in a circle of 1.25 feet radius, to be 7,650 pounds. This furnishes a simple rule for calculating this force. Multiply together the weight of the reciprocating parts, the length of the crank in feet, and the square of the number of revolutions per minute, and multiply the product by decimal, .000341. Thirdly. This identity is practically proved by the fact that the reciprocating parts are balanced in the horizontal direction, by an equal weight revolving opposite to the crank, and at the same distance from the center. Fourth. An examination into the nature of the force itself shows that it *is* centrifugal. What is centrifugal force? It is the resistance which a moving body offers to being deflected from a right line, or, as it is radially at rest, its right line of motion being across the radial line at right angles, it is its resistance to being put in motion toward the center from a state of rest, and the amount of this motion is the versed sine of the angle; a definition which exactly describes the force under consideration.

But what is the influence of this action on the problem of high piston speed?

We see that it makes any engine, in effect, a rotary engine if the steam is shut off, the crank passing the centers under the strain of the centrifugal force of the reciprocating parts. But, at ordinary speeds, this force is developed only in a small degree, varying from two to ten pounds for each square inch of piston area, and, of course, the force of the steam is only to this extent expended in overcoming it, the excess becoming at the instant of its admission effective against the crank. Nor at more rapid speed does it become of marked value, unless considerable weight in the reciprocating parts and a short stroke are employed, since it increases directly as the mass, and inversely as the diameter of the circle with a given piston speed. By combining however, rapid speed and short stroke with considerable weight in these parts, their centrifugal force may be developed to whatever extent we choose, and, if it is in excess of the force of the steam, the engine with the steam turned on, becomes in effect a rotary engine.

The crank passes the centers under a strain not wholly relieved ; the force of the steam does not reach the crank at these points, but is absorbed in the mass, and is afterward gradually imparted to the crank during the stroke. The value of this action is certainly difficult to estimate too highly. By means of it the shock of the steam on the centers is avoided wholly or in any degree, the excessively intermittent pressure caused by working steam at a high grade of expansion is transformed, as by magic, into a steady and rotative pressure on the crank, the fly-wheel is relieved of its most trying offices, and the shaft from the excessive tension in alternate directions that is produced by its action, and a smooth and gliding movement is attained, with a closer approximation to uniform motion than the crank has been supposed to be capable of giving.

It is curious to observe how exactly opposite to the truth all the engineering traditions on this subject turn out to be. We have been taught that the reciprocating parts of an engine were passive on the centers, that the great difficulty encountered in the attempt to employ high speed was the necessity of reversing their motion, that they should therefore be made as light as possible, and long strokes should be employed so that the changes in the direction of their motion might be as few as possible.

Now we know that their centrifugal action on the centers is all important to a high speed engine, and that to render this most serviceable we must employ considerable weight and a short stroke.

The field is a large one ; I limit myself to the fundamental principle, which I have endeavored to explain. This being established all theoretical objection to the employment of high speed vanishes. When the dead center is stripped of its imaginary terrors, we must perceive the dawn of a new day in the history of the steam engine.

The Chairman remarked that locomotives had always run at a high rate of piston speeds and yet in a very smooth and comparatively economical way.

Mr J. B. Root.—There is no doubt whatever of the truth of the proposition presented by Mr. Porter. The inertia of the parts should be sufficient to take up the power of the steam at the beginning of the stroke and give it off at the close. I have built many short-stroke engines and find they run smoothest when the parts are the heaviest. It is possible to get a heavy loss in an engine with light reciprocating parts simply by the use of a heavy fly wheel.

Mr. Fisher asked the effect of a very heavy piston combined with a short cut off.

Mr. Porter said that in such a case the piston may be considered as a projectile. Take a very heavy piston as an extreme case, say one whose inertia would be 1,000 pounds to the square inch, and use steam at 100 pounds to the square inch, the action of the fly-wheel, in such a case, would be reversed. An engine could not be made to stand the blow if the reciprocating parts were without weight. Between the extremes of enormously heavy reciprocating parts and reciprocating parts without weight, we have a mean which can be reached, and at which our engines can be made to perform perfectly.

The Chairman asked if the weights were properly proportioned for a slow motion, would they run at any speed?

Mr. Porter replied that they would not run as well.

The Chairman remarked that millions of dollars had been spent in this country upon rotary engines. It is now shown that they are not needed.

Mr. C. E. Emery.—There is no doubt in regard to the facts enunciated in the paper just read. I think Mr. Porter is deserving of many thanks for the clear manner in which he has explained the matter. There is more power absorbed at the beginning of the stroke than at any other part. There is an inert mass to be put in motion. This inertia is overcome by the highest pressure of the steam.

The speaker then drew an indicator diagram upon the board, illustrating the pressure of steam upon the pistons, showing the rapid fall of the pressure from one end of the stroke to the other. Upon this diagram another was drawn in dotted lines, showing how the inertia of the reciprocating parts stored up the force of the steam, giving it out after the half stroke has been reached. He then said that by a proper porportion of the parts he thought it would be possible to make the pressure upon the crank pin so uniform that it would be represented by a straight line, or one very nearly straight, the indicator diagram remaining the same in each case. Locomotives have been run for years at high piston speeds. The reciprocating parts were not as heavy as the theory would indicate, but by means of early exhaust, considerable cushioning, and moderately heavy weights, they had reached nearly the same results. He wanted to know how we were to reach the high piston speeds; whether by the means used by locomotive engineers, or in the way proposed by Mr. Porter, or by a combination of the two. It was a question, however, which must be left to those who had studied the matter.

Mr. Root.—The principle Mr. Porter has explained is an exceedingly important one to short-stroke engines. I have found in my experience in building engines of this class that with heavy moving parts they work very easily. Sometimes with light parts this cannot be done.

Mr. Fisher.—Undoubtedly Mr. Porter's system is very important. By means of it, it becomes possible to correct the inequalities which arise from cutting off short.

JAPANESE TIMEPIECE.

Mr. D. W. Bradley exhibited and described a very curious Japanese clock. It was so arranged that the hours were made longer and shorter according to the length of the day. It must be wound every morning at sunrise. The day was divided into six and the night into six parts.

Adjourned.

January 26, 1871.

Prof. S. D. TILLMAN, in the chair; ROBERT WEIR, Esq., Secretary.

The Chairman presented the following interesting scientific items:

NEW PROCESS OF CASTING METALS.

The London *Quarterly Journal of Science* says that a considerable number of gentlemen lately met at the Lancashire Engineering and Compression Casting Works of St. Helen's Junction, to witness the new process of casting in brass and iron, chased and embossed work of the most elaborate description. The process, which was then for the first time exhibited in England, is an American invention, and its utility was shown to consist in this—that any design, whether in high or low relief, chased on metal of any required pattern or shape, whether flat as a door plate or round as a vase, can be reproduced by casting, *ad infinitum*, and each casting will show upon it all the sharpness of the original chasing. Molds are made with a preparation of fine clay. The making of one of these molds takes from five to ten minutes. They have then to stand twenty-four hours exposed to dry air, after which they are baked in a furnace for eight hours. These clay moulds, into which the metal is afterwards poured, are, to all intents and purposes, encaustic tiles. The moulds are placed in a box, and the air is extracted from them so as to form a vacuum, after which the molten metal is forced into them; and in this way, in ten minutes, a casting can be completed. When the casting is taken out, the design, however intricate, is found to be perfectly represented, with the exception of removing a slight surface of clay from it, which can be done in half an hour, and the article is then ready to be sent to the bronzer, instead of having to be put in the chaser's hands. In this way an enormous amount of cost and labor on ornamental articles in metal is saved.

Artificial Preparation of Indigo.

The *Industrial Gazette* of Chemnitz, Saxony, says that in the beginning of 1870, Baeyer and Emmerling, of Berlin, found that indigo might be prepared from isatin, which latter may be produced from cinnamonic acid. This mode of preparation, however, was attended with a serious drawback, on account of the difficulty of obtaining the cinnamonic acid. Quite recently, however, Emmerling and Engler discovered that the same result may be accomplished by means of benzoic acid, which is quite easily obtained from the urine of horses. It is expected that by improving this method, the importation of indigo from oriental countries will be considerably diminished. A mixture of benzoate of lime with acetate of lime, if subjected to distillation, yields a compound which may be regarded as the alcohol of benzoic acid, in which the hydrogen of the water has been replaced by the radical methyl. If this body is treated with strong nitric acid, a product containing nitrogen is obtained, in which one atom of hydrogen is replaced by one atom of hyponitric acid. The *Gazette* gives the formula of this reaction, which is here omitted, but it will be readily understood when we state that it only differs from the chemical formula of indigo blue in having a surplus of two atoms of hydrogen and two of oxygen. Now, by simply adding hydrogen, which is accomplished by heating the compound with a mixture of soda, lime and zinc dust, water is formed, and indigo is obtained, although in very small quantity. We may here remark that Baeyer is also the author of the artificial preparation of the principal pigment from madder, alizarin, which is now manufactured on a large scale in Germany.

ON THE MELTING OF LEAD PROJECTILES BY IMPACT.

In *Poggendorf's Annalen*, Mr. E. Hagenbach applies the mechanical theory of heat to account for some of the results of the experiments recently made at Basle, with the view of using targets of iron instead of wood in practice with fire arms. Strong plates of iron were fired at from the distance of 100 paces. Conical bullets, by their impact against the iron plates, produced scarcely perceptible indentation, and fell down near the target; at the same time the lead projectile was melted to a very considerable extent. This could be recognized by the fact that around the point where the ball had struck, the plate was spattered with lead in the form of a white star; that, moreover, the melted lead was found in the vicinity, and that of the original bullet, which weighed forty grammes, only the comparatively small portion of thirteen grammes remained. By the author's calculation, the force expended on the ball gives, as mechanical equivalent of the heat, 0.49 thermal unit. He then proceeds to inquire how much heat is necessary to produce the melting described. The entire projectile (forty grammes) had to be raised to the temperature of the melting point of lead, or near it, and the twenty-seven grammes had to be melted. Assuming 100° C. as the initial temperature of the ball, which was somewhat warmed by the heat of combustion and by friction, the melting point of lead being 335° C., its specific heat 0.031, and its latent heat of fusion 5.37, he finds necessary for heating 0.29 thermal unit, and for fusion 0.15, giving a total of 0.44 thermal unit, this being only .05 less than the estimated mechanical equivalent. Thus the mechanical theory of heat sufficiently accounts for the operation. Almost all the impetus of the motion of the body is transformed into heat—a result which was indeed to be expected, seeing that the iron plate was very slightly deformed, and the projectile rebounded but little. By far the greater portion of the heat was used in heating and melting the lead. This is also readily understood, for the short time within which the entire process was effected, could give rise to but little loss by conduction and radiation.

SIEMAN'S PYROMETER.

This instrument was the subject of considerable discussion at the last meeting of the British Association for the Advancement of Science. It is entirely unlike those pyrometers which indicate high degrees of temperature by means of the difference in dilation of two solids exposed to the same temperature. Such pyrometers have been found untrustworthy, principally from two causes. First, the rate of expansion, on exposure to regularly increasing heat, is not uniform. Second, certain metals and other solids do not resume their original length after being heated and cooled. The indications obtained from pyrometers of this class, exposed to very high temperature, have never been trustworthy; hence, there has been such uncertainty as to the actual heat used in many chemical experiments that no definite conclusions could be arrived at as to the actual temperature required to accomplish a desired change. Mr. Sieman's pyrometer has taken advantage of the fact that electric force passes more slowly through a platinum or an iron wire in proportion as it is exposed to higher degrees of heat. Platinum, moreover, required a higher heat to reduce it than any other metal, since it only yields before the flame of the hydro-oxygen blow-pipe. It can, therefore, be used to measure any degree of heat generated by the combustion of carbon. Mr. Sieman's apparatus for measuring high temperatures, for instance those of the smelting furnace, consists of a coil of fine platinum wire, which is wound on a cylinder of burnt clay, having on its surface spiral grooves into which the wire fits, thus protecting the wire and insulating it, so that the current must pass through its whole length. That wire is connected at each end with a copper wire, which carries the current of electricity to the ordinary galvanometer, where the actual force of the current is indicated, and the movement of its needle becomes a correct index of heat. For temperatures below a red heat an iron wire may be substituted for the platinum. The instrument prepared for Dr. Carpenter, and successfully used by him in ascertaining the temperature of the sea at great depths, consisted of a fine insulated iron wire, several miles in length, inclosed in a hermetically sealed tube, to project it from the influence of moisture and rusting. The platinum pyrometer has been successfully used in the imperial iron works of Russia, and in gas works where the temperature of the coal distilled materially influences the quality of the gas. A great advantage in the use of this instrument is, that the record of changes may be made many miles distant from the point where the wire is exposed to heat.

The Solar Eclipse of 1870.

Professor Young, of Dartmouth College, one of the United States Scientific Corps sent to Europe by our government to make observations of the solar eclipse of December 22, 1870, which was total in portions of Spain and in Sicily, has sent the following communication to Professor Morton, which, from the known failure of several other corps to obtain reliable observations on account of unfavorable weather, will be read with increased interest:

"By the courtesy of Professor Winlock, I am permitted to communicate the general results of our observations on the eclipse. I think I may say that, on the whole, our expedition has been highly successful, though more might have been accomplished had the weather been better. We seem, however, to have been more favored even in this respect than any of the English parties observing in Spain. From those in Algeria and Sicily I have not yet heard. The day and night previous to the eclipse were very fine, but early in the morning it clouded over, and when we arose the prospect was very gloomy. It even rained from time to time. We made all our observations, however, and before first contact (10.25 A. M., local time), there were many patches of partly clear sky, but there was always, even when clearest, enough haze of frost crystals to cause the sun to be surrounded by a conspicuous halo of 22½° radius.

"At the time of first contact it was clear enough to allow good observations to be made in the usual method. I attempted to use the spectroscope upon it in the same manner as last year, but failed on account of the thin cloud which most of the time entirely obliterated the chromosphere lines. Between the time of first contact and totality, there were several intervals of moderate clearness, in which photographs of the partial phases were taken. Just before totality the clouds became much thicker, and we nearly gave up hope; but at the needed time, almost by the direct interposition of Providence, as it would seem, a small rift in the now heavy clouds passed over the sun, and permitted us to observe the sublime phenomenon, if not in all the beauty and sublimity of last year, yet satisfactorily and most gratefully. Within five minutes after the end of totality the sky was wholly clouded, and we did not see the sun again until near evening, after a heavy storm of wind and rain. During the totality, one good photograph of the corona was obtained with the six-inch glass with an exposure of one and a half minutes. It is, of course, by no means so good as it would have been had the sky been truly clear, but it shows a great deal of detail, curved filaments, and radial shadings far better than ever before obtained. The picture produced with the eight-inch glass was injured by not being removed until the sun came out. No attempts were made to photograph the prominences, which can be seen and studied at any time. All efforts were concentrated on the corona.

"In respect to the polarization of observations, there is reason to suppose that there must have been some peculiar defect in the particular instrument Prof. Pickering used last year, as his assistant, Mr. Ross, using it on this occasion, obtained the most unsatisfactory result. But, apparently similar instruments, used this year, together with others quite different in construction, indicated radical polarization of the corona. The appearances in the instruments were much complicated by the cloud and haze, but I believe Prof. Pickering and Prof. Langley both agree that the corona certainly has a considerable proportion of its light radially polarized. Our spectroscopic results completely confirm those of last year, and except that the two faint lines which I saw between D and E last year, and suspected to be corona lines as well as 1474, were not seen at all this time; 1474 was traced by Prof. Winlock to a distance of nearly 20′ from the sun's limb. I traced it 16′ on the west, 12′ on the north, 14′ on the east, and about 10′ on the south. The principle chromosphere lines were also visible in the corona to a distance of 3′ or 4′. Prof. Winlock and myself both agree in attributing this to the reflection of the haze around the sun. I am more confident as to this, because last year, in a clear atmosphere, the C line was certainly sharply terminated at the upper limit of the chromosphere or prominences under observation. Mr. Abbay, in his spectroscope, saw only the 1474 line and the F line; the former was considerably the brighter of the two. He saw no continuous spectrum.

"But the most interesting spectroscopic observation of the eclipse appears to me to be the ascertaining of the chromosphere, and, of course, in immediate contact with the photosphere, of a thin layer in whose spectrum the dark lines of the ordinary solar spectrum are all reversed. Just previous to totality, I had carefully adjusted the slit tangential to the sun's limb at the point where the second contact would take place, and was watching the gradual brightening of 1474 and the magnesium lines. As the crescent grew narrower, I noticed a fading out, so to speak, of all the dark lines in the field of view, but was not at all prepared for the beautiful phenomenon which presented itself when the moon finally covered the whole photospere. Then the whole field was at once filled with brilliant lines, which suddenly flashed into brightness, and then gradually faded away, until, in less than two seconds, nothing remained but the lines I had been watching. The slit was very close, and the definition perfect. Of course I cannot positively assert that all the bright lines held exactly the same position that had been occupied by dark ones previously, but I feel very sure of it, as I particularly noticed several groups, and the whole arrangement and relative intensity of the lines struck me as perfectly familiar. Mr. Pye saw the same thing, for an instant only. Prof. Winlock did not, as his telescope at the time, in accordance with his directions, was pointed to a spot at some distance from the sun's limb; neither did Mr. Abbay see it. This observation is a confirmation of Secchi's continuous spectrum at the edge of the sun, and I think tends to make tenable the original theory of Kirchoff as to the constitution of the sun and the origin of the dark lines in the ordinary solar spectrum. I cordially acknowledge the courtesy and kindness of the inhabitants of Jarez. Everything possible was done to assist us and make our stay agreeable.

"C. A. YOUNG."

Mr. Charles B. Boyle said that he called attention, a year ago, in reference to the photographs of the total eclipse exhibited in the Fair of the American Institute, that along the moon's edge there was a halo. Since the disc of the moon was as black as the field of the sky, had this halo not owed its origin to the moon, it would have extended around the whole edge of the solar disc. Possibly the thin layer which Prof. Young discovered is connected with the same cause which produces this halo.

The Chairman.—This may tend to confirm a theory I advanced several years ago before the American Photographical Society. All bodies throw off heat, and heat is but vibratory motion. I took the ground then, that the moon must throw off vibrations of light and heat which did not reach us, but which, at some time or other, we should ascertain to exist. Just as even a piece of cold iron is throwing off heat, which it will communicate to a body colder than itself, so every body in the universe, from the largest suns, the planets, the moons, down to the smallest atoms, is constantly, and must be from the nature of its constitution, throwing off vibrations. In the case of a solar eclipse, the sun being at a vast distance behind the moon, some of its light passing by the moon's edge will suffer a slight reflection; and these rays combining with the moon's invisible rays will give us the luminous appearance along the edge of the moon.

Mr. Boyle.—If this were due, not to refraction but to reflection, I think we should have the halo before the moon comes in contact with the sun.

The Chairman.—You cannot see this with the eye; it is only in the picture that we see it.

Mr. Boyle.—We see falsely with the eye. You will remember that in the lecture of Dr. Gould, of Cambridge, before the Institute a year ago, he showed us a number of pictures painted from the eye, and photographs, and that the photographs showed us things entirely different from what the eye did, for the reason that the eye sees falsely. There is the bright disc of the sun, and it is remarkable that this should be brighter than the disc. I know of no optical means of accounting for it, excepting by the refraction of the light from the sun, passing by the edge of the moon.

The Chairman.—What produces the refraction?

Mr. Boyle.—The refracting medium about the edge of the moon.

The Chairman.—How do you know there is any?

Mr. Boyle.—From the refraction. I regard this very phenomenon as an argument in favor of the existence of an atmosphere around the moon. The gradually decreasing brightness of the illuminations corresponds with the results which would naturally follow from refraction by an atmosphere, gradually becoming less dense as we rise above the surface. I have found that I could distinctly trace this luminous appearance to a height of 36 miles above the surface of the moon. The refraction of the earth's atmosphere at the level of the sea is less than a degree and a half; one-half of which is the horizontal refraction we can observe. Now the height of the lightest cirrus clouds is only about three miles. If the atmosphere of the moon was equal to the height of our cirrus clouds, it would not lift the aqueous vapor of the moon high enough to become visible. Yet many observers have supposed, and I think they must be correct, that they have seen clouds in the moon, over some of the basins on the moon's surface. If they have seen clouds, there must have been an atmosphere to sustain them. It must be remembered that in observing an occultation, we do not see the general level of the moon, but the edge of the disk is composed of the tops of the lunar mountains, about a mile, on the average, above the general level. The fact that the axis of the moon directed toward the earth is prolonged, makes it the more certain that there will be mountains enough along the edge to prevent our seeing below their tops. At the height of our cirrus clouds, the earth's refraction would probably be less than one-quarter what it is at the sea level; and at the top of the moon's mountains, the refraction would be still less; so that it would be impossible for us to see whether there is any dip in the stars occulted or not. One observer has supposed he did see stars dip; but if that were so, it would argue a very dense atmosphere indeed.

In this connection I desire to explain to you an instrument I presented to Dr. Doremus last summer, the object of which was to photograph the photosphere. In order to avoid the sun's light, I cut an elliptical hole in a metallic plate, placed at an angle of forty-five degrees in the cone of rays from the sun, of such form and rise that the rays from the disk itself shall pass through the hole, while the rays from the photosphere, immediately around it, shall be reflected to one side, to produce the photograph. It has been suggested by Dr. Draper that the luminous condition of the earth's atmosphere would prevent photographing the photosphere by this means. If that is all the objection, it strikes me that such an apparatus might be successfully employed upon the tops of our highest mountains, and the entire photosphere of the sun might be photographed every day.

ON THE SHIP WORM AND THE MEANS OF PREVENTING ITS RAVAGES.

Read by Dr. Adolph Ott.

The extensive destruction of submarine works caused by the teredo navalis or ship worm, prompted the Royal Academy of Sciences in Amsterdam, in the year 1858, to appoint a committee to investigate the natural history of this singular animal, and the remedies proposed for preventing its attacks. The results of these investigations, of which we shall only present the most important ones, have now been published by E. K. von Bumhauer, in the "Mededeelingen d. k. Acad. v. Wetensch."

The mode in which the boring mollusks (for there are several of them) perforate all bodies, from the softest wood to the hardest stone, has been the subject of various opinions; yet, it is now generally considered by naturalists, that the rock-boring mollusks are capable of secreting a liquid which corrodes stone, while others, like pholas and teredo, bore by physical action.

As to the teredo navalis or ship worm, it belongs to the acephalous or headless mollusks, the same zöological division as the oyster. It is enveloped by a shell and mantle, which form a sort of sheath communicating by two syphons with the exterior. The shell itself consists of two valves of equal size, which are united by a fold of the mantle in such a manner as to permit of only very slight movements. The surface of the shell, upon examination with a magnifying glass, presents a striated and indented appearance, especially toward the margins. (The wedge-like teeth present a length of 1.65 lines.) These striations are not uniformly distributed over the shell, but upon the anterior, thicker and spoon-like part, they run nearly in a straight angle toward those of the center. It is estimated that both valves together bear 20,000 teeth. We will remark that as long as the animal grows, new and sharper teeth are constantly formed, which substitute the older and blunt ones.

The fecundation takes place by the contact of the syphon with that of an individual of the other sex. The females, of which there are about twenty to one male, lay eggs. These are expelled in June, through the syphon, and on the fourth day are already transformed into larvæ, which are capable of attacking wood. M. Kater has seen them at the end of June in large masses upon wood, and on the fifteenth of July he discovered grown up mollusks in its interior.

The teredo bores at first a very small aperture in a direction perpendicular to the surface, but it changes its route after a while, in order to follow the direction of the fibers. In the first stage of its development, this imperceptible but none the less dangerous miner has only one syphon, but later another is formed. They are of unequal lengths. Both seem to serve for secreting the fæces, which mostly consist of pulverized particles of wood, forming a very fine white mass. It seems that the shorter syphon is principally used for this purpose, while the longer one serves for the reception of food, consisting of infusoria, diatomes and other lower organisms. The bore-worm requires pure, clear water, with a certain amount of salt. If the sea water is mingled with much fresh water, the animal dies.

It continues to grow in the wood. At first the diameter of the groove is only half a millimetre, but gradually reaches five millimetres and more. The teredo itself acquires a length of from one foot to one foot four inches. It usually attacks that portion of the wood lying between low and high water marks, and if it is sometimes found above the water, it is because the timber has retained a sufficient degree of moisture. At Ostend, where the teredo abounds, it has been found in all situations below six feet three inches (1.90 met.) above the low water mark of spring tides.

In its abode, the margin of the mantle secretes calcareous matter and deposits it on the inner wall of the cell. This deposit is at first quite soft, but soon becomes hard. Between this calcareous layer and the animal there is, however, left sufficient space so as not to hinder the little miner in its movements. Strange it is, but however multiplied may be their tubes in the same piece of wood, they never mingle, so that between two tubes there is always left a partition wall, though sometimes a very thin one. "The wood," says Louis Figuier, in his admirable book (The Ocean World), "is thus attacked at a thousand diverse points, until it is invaded and its entire substance destroyed. Submarine constructions upon which bridges are built are often riddled and perforated. They appear to all outward examination as solid and perfect as at the moment they were first erected; but they yield to the least force, bringing ruin and destruction on the edifices they support. Ships have thus been silently and secretly mined, until the planks crumbled into dust under the feet of the sailors. Others have gone down with their crews, owing to the ravages of these relentless enemies, which are horrible from their unapproachable littleness."

If removed from the salt water, the teredo dies within twenty-four hours, while if taken out of the wood, it continues to live in sea water for three or four days. Its abode in the ligneous tissue is therefore a condition of life. In a worm belonging to the annelidæ (*lycaris fucata*), which is always found in the wood excavated by teredo, we find an enemy of the latter. This parasite attaches itself to the entrance of the tube, sucks itself to the teredo and devours it slowly. It then seeks another victim. It has a length of from four to six inches, and is provided on both sides with numerous hairy feet. Behind the head, which is provided with a powerful masticatory apparatus, there are four pairs of tubular appendages.

Formerly, it was supposed that the naval worm was a native of the tropical zones, but the discovery of closely related species in the tertiary layers and various discoveries of excavated pieces of timber in more recent deposits have proved the fallacy of that supposition.

The circumstance that the teredo appeared in enormous hosts in the years 1731, 1770, 1827, 1858 and 1859 has also led to the discovery that an unusually large increase takes place whenever, by lack of rain, the rivers run low, thus augmenting the proportion of salt in the sea near the coasts.

For a long time past, various means have been proposed in order to preserve timber used for marine purposes from the attacks of the teredo. To gain an insight into the efficiency of these alleged remedies, the Academy of Sciences of Amsterdam instituted a series of experiments, which were conducted by Messrs. W. Vrolik, P. Harting, D. Storm-Briegsing, S. W. L. Von Oordt and E. H. Von Baumhauer.

In reporting these experiments, the author, Mr. E. H. Von Baumhauer, calls attention to the fact that upon the great devastations caused by the teredo in 1858 and 1859, a number of secret remedies were offered to the government. The scientific committee had considered it its duty not to leave any one of them untried, although there were many among them which it could be foreseen would be inefficient; and in order that no objections could be made upon the part of the members, they were allowed to conduct the trials themselves.

The experiments were made in the harbors of Kissingen, Harlingen, Stavoren and Niervendam, with piles of oak, pine and fir, some of which were prepared, and others left in a natural condition, so as to serve as counter proofs. The piles were mostly three and a third feet long and of a cross section of two to three square feet. Three classes of experiments were made:

1. The external coating, with paints and other substances.

2. The impregnation of the wood with substances by which the appearance of the surface as well as that of the interior is changed.

3. The use of very dense exotic wood.

In the experiments of the first class, the following compositions were tried:

(1.) A composition of classen, kept secret.

(2.) A metallic paint of classen, also kept secret.

(3.) A composition of brinkerink, consisting of Russian tallow, coal tar, rosin, sulphur and powdered glass, applied warm and after the wood had been roughed. The layer was several lines thick.

(4.) A composition of rijhwyk, somewhat similar to No. 3.

(5.) Paraffine varnish, obtained by dry distillation of peat.

(6.) Coal tar, applied cold and warm in several layers upon wood externally carbonized. Into some piles holes were bored, which were filled with hot tar and then shut, so that the tar could penetrate into the interior; some piles were also covered with a mixture of tar and oil of vitriol, to which sal ammoniac, turpentine and olive oil had been added.

(7.) Turpentine with linseed oil paints; among them chrome green and verdigris.

(8.) The surface of the wood was merely carbonized.

The thus prepared piles were immersed in the water at the end of May, 1859. When taken out in September of the same year, it was found, that with the exception of No. 6, none of those alleged remedies had proved effective. The timber coated with the composition No. 6 showed only traces of the attacks of the teredo, but in the fall of 1860, or after one year and a half, it presented a great number of excavations.

The results of these experiments convinced the committee in the most satisfactory manner that no external application furnishes protection. Although such a one may prove useful for some time, the slightest crack or abrasion, produced by the action of the water, ice, or other causes, will form an entrance for the young teredo.

It may here be well to say a word about the coating with iron nails, which, although very expensive, is still largely in use. If this means is to afford protection at all, the square heads must well join together, and the piles, before being immersed, ought to be exposed to the action of the atmosphere, so that the surface of the iron may rust well and fill the spaces between the heads. And yet the committee on examination reports that some piles, coated in this manner, exhibited, after years, perforations of the ship worm, although they had been covered with a layer of iron rust over an inch thick.

Concerning the sheathing of lock-gates with iron, copper, or zinc plates, a process often used, it is evident that if this covering remained complete no penetration of the wood could possibly occur. Experience, however, has shown that these plates furnish no enduring protection, owing to the fact that it is impossible to maintain an unbroken or unbrased surface. It has been discovered that nature itself affords a better protection in the case when sea-shells attach themselves to the gates before the larvæ of the teredo have had time to begin their attacks.

In experiments of the second class the following alleged preventives were tried:

1. Sulphate of Copper or Blue Vitriol.—The piles were impregnated in Amsterdam, but it was found in the summer of 1859 that this process was unsuccessful. Yet, in order to be certain that this was really the case, the committee ordered from Paris two logs of beech-wood with the bark, two without the bark, and two logs of pine-wood, all of which had been saturated with a solution of sulphate of copper. These pieces also proved valueless, and the experiments only confirmed the results obtained by the engineer Noyon.*

2. Sulphate of Iron or Green Vitriol.

3. Acetate of lead.

Impregnation with these salts yielded negative results; also,

4. Soluble Glass and Chloride of Calcium.—In order to form a silicate of lime in the pores of the timber the piles were first saturated with the soluble glass and afterward with chloride of calcium. Before they were immersed in the water they were exposed to the air for half a year, so as to effect a perfect chemical union. In March, 1862,

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* Sur l'inefficacite du procede Boucherie en eau de mer. Annales Pouts et Chaussees, Mars et Avril, 1859.

these piles were placed in the water, and, on examination in October of the same year, it was found that the teredo had caused great ravages.

5. Creosote Oil.—This is a product of the dry distillation of coal tar, which by a second distillation, is purified from the most volatile as well as from the heavy oils. In the month of May, 1859, pieces of wood saturated with oil of creosote were placed at Vlissingen, Harlingen, and Stavoren, in the sea. In September of the same year they were all found free from worms, while other unimpregnated pieces, that had been placed beside them, had been thoroughly invaded. Another trial was made in July, 1860, with ten piles of oak and pine, treated with creosote; and later, piles of beech and poplar were employed that had been treated by Boulton in England.

All these piles were examined in the fall of 1862, '63 and '64. While those that had been left in their natural condition had been thoroughly invaded, the oak only showed traces of the worm; but, in sawing one of the oaken piles through, the wood was found to have been very imperfectly saturated.

On investigation in the year 1864 it was found that the piles of pine, beech and poplar, treated by Boulton in England, were perfectly sound, although exposed to the action of the toredo for three years; indeed, not the least excavation could be discovered. After a layer of a certain thickness had been cut off from them they were again immersed, and proved also this time to be perfectly worm-proof.

The same satisfactory result was obtained with piles impregnated by a company in Amsterdam. They had remained in the water for five years. In none of this wood, not even in that which had several times been deprived of its surface layers, could a trace of the ship-worm be discovered. Of the unprepared wood that had been served as counter-proof, nothing but the head pieces over the water had been left; the rest had become a spongy mass of no strength.

In all the impregnated piles of oak there were here and there traces of the toredo, owing probably to the circumstance that the oil penetrates with difficulty into this kind of wood. It had finally been recommended to the committee to use petroleum, but, owing to its high price, no trials were made with it.

Under the third head various exotic woods, some of great hardness, were tried. However, the experiments made with them were only a few. It can only be said with certainty that some species of wood from Surinam, American oak, and several others, were not spared.

The committee on investigation also received a heavy piece of Guajac wood, which had been laying for five or six years in the sea at Curacoa. Being thoroughly perforated, it afforded the best proof that even the densest wood is useless for sub-marine constructions.

The committee finally received communications on wood reputed to be poisonous to fishes, but has had no opportunity of proving or disproving these statements. It was proposed, therefore, by the Dutch government to make inquiries in the East as well as the West Indies.

The report of the committee sums up with the following conclusions:—1. That mere external coating of the timber with paint or other substances affords no protection; since it is impossible te maintain an unbroken surface, the young toredo will enter the slightest crack or abrasion. The use of copper, zinc or galvanized iron plates is too expensive for most occasions; and even these become of no use when broken. 2. Impregnating wood with soluble inorganic salts which are poisonous to animal life, furnishes no protection against the worm. This is due to the fact that the sea water soon dissolves away their strength, and that the worm does not devour or digest the wood bored out by means of the shelly jaws. 3. The hardness of the wood and its poisonous character, so far as known, are of no avail. 4. Creosote oil is so far the only substance met with that constitutes a true protection against the worm. Attention should therefore be directed to the best and quickest methods of saturating the wood with this material, and to the kinds of wood most absorbent of it. The creosote oil doubtless owes its peculiar powers in the respect just indicated mainly to the carbolic and cresylic acid it contains, and we have thus another illustration of the important applications to be made of the latter sustabnces in our domestic and industrial economy.

Similar testimonials as to the efficacy of creosoting have from time to time been given by eminent engineers and scientists pursuing the study of applied science. In a work published in Paris in 1868, and entitled "*Memoire sur la conversation des bois a la mer,*" Mons. A. Forestier states, for instance.

"Our studies and experiments have entirely convinced us that all of the numerous processes hitherto known, the only one thoroughly efficacious is that which consists in thoroughly impregnating wood with creosote."

In his evidence, given before the select committee on harbors of Refuge, Mr. Abernethy said:

"I am convinced that timber, when creosoted is not subject to the action of the worm, so far as my actual observation goes; and in that case probably I am understating it when I say it would last for half a century at least."

The earliest wood creosoted and exposed to the sea in harbors, was at Lowestoft.

At the meeting of the institution of Civil Engineers, Mr. T. E. Harisson remarked, that the entrance gates of Monk-Wearmouth docks at Sunderland, which had been constucted of yellow pine, creosoted twenty years ago by Mr. Brunel, were quite sound, but portions of kyanized timber, used in the same works, had been attacked by the worm to a considerable extent.

The use of creosote oil for preserving wood was introduced in 1838 by John Bethell. In the beginning the oil was valued merely as an antiseptic, but it is now generally agreed that it is not less useful in filling the pores of the timber so as to exclude air, water and putrescent matter.

Concerning the plans proposed for impregnating wood with creosote we propose to briefly consider the most remarkable ones.

I. The Pressure Process.

The wood and liquid being contained in, and nearly filling a closed and strong iron receptacle, more liquid is pumped in till a high pressure is attained and the liquid is forced into the pores of the wood. The pressure required for the purpose approaches 200 pounds to the square inch, and the apparatus is consequently very heavy and very expensive. Only well-seasoned and dry wood is suitable for the process as it is evident that if the pores of the wood be occupied with sap, no amount of simple pressure will condense the sap to permit the entrance of the preservative liquid. The great cost of setting up and working this process, and the fact that it cannot be effectively used for unseasoned lumber have prevented its extensive introduction into the United States.

II. The Vapor Process.

This process was first carried out on an extensive scale by Lucken in 1811, and was revised in England by Frank Moll, in 1835, and quite recently by Mr. L. S. Robbins, in the United States, who brought it before the public as a "Discovery of one of the Lost Arts of the Egyptians." This plan was proposed at a time when the value of antiseptics was over-estimated, and when the necessity of sealing the pores of the ligneous tissue was overlooked. It was also supposed that by simply exposing the wood to the vapor of coal tar, a sufficient amount of the antiseptic would be carried into the pores to afford perfect protection. Leaving out of question the injury to the wood by the high heat, necessary to volatilize the products employed (from 400 to 700° Fahrenheit), it is evident, since the space occupied by creosote vapor is 1,100 times that of the same weight of liquid creosote, no available amount can be got into the wood. And, even if it should be completely permeated, no useful end will be attained, owing to the fact, that the vapor on condensation will leave the pores empty.

III. THE SEELY PROCESS.

The writer has already had occasion to call attention to this process, by which within the past three years, large quantities of railroad, dock and pavement timber have been successfully treated. Although one of the most recent processes, it has attained a high reputation and is already spoken of as the only one fulfilling the requirements of scientific and practical investigation.

The process, in brief, consists in subjecting the wood to a temperature above the boiling point of water and below 300° while immersed in a bath of creosote oil for a sufficient length of time to expel the moisture. When the water is thus expelled, and the pores contain only steam, the hot oil is quickly replaced by a bath of cold oil, by means of which change the steam in the pores of the wood is condensed, and a vacuum formed, into which the oil is forced by atmospheric pressure and capillary attraction. Among the advantages of this plan, the following may be named: The thorough air-drying which is required by the pressure process is obviated; the expulsion of the sap, and the amount of oil forced into the wood, is perfectly under the control of the operator; any desired fraction of the vacuum of the pores may be filled at pleasure. On examination of wood saturated by Seely's method of treatment with the microscope, the writer found every pore completely filled with oil, and this not only on the surface, but also in the center of the piece examined.

Adjourned.

February 16, 1871.

Prof. S. D. TILLMAN, in the chair; ROBERT WEIR, Esq , Secretary.

A NEW BATTERY AND ELECTRO-MAGNET.

Mr. Emile Prevost submitted the following paper:

"I beg leave to recommend to a fair trial two inventions of general interest in the matter of progress in electricity and its most economical, useful and practical applications.

"1st. The new liquid, chromic acid, patented July 22d, 1870, honorably mentioned at the American Institute fair of 1870. I would respectfully call the attention of scientific men and all others using electric batteries to the various merits of this new liquid; its economy, strength, durability and evenness of action are unsurpassed. It supersedes nitric acid in the batteries where the latter has been employed till now. This new liquid, chromic acid, that we will sell at retail at seven cents a pound, can also be used instead of the old bi-chromate of potash liquid in the batteries using one liquid, called the bi-chromate of potash batteries.

"2d. To an electro-magnet of great power, bearing a heavy weight, unsurpassed till now, and worked only by two of Bunsen's cups, where nitric acid is suspended by the new liquid chromic acid.

"After fifteen years of severe labor, study and perseverance, I am now able to say that I have got a perfect knowledge of the experiments and tests made by Messrs. Lentz, Jacoby, Muller, Dub, Nickles and Becquerel, on the strength of electro-magnets, and I am entirely satisfied that I know the conditions to be fulfilled to obtain powerful electro-magnets able to be used as motive power to machinery with decided economy, as there will be no longer any use for large sized batteries as before; and also by the quality of my electro-magnets which I get up, such as to be fully satisfied of their molecular efficiency."

The Chairman.—I understand that the liquid which Mr. Prevost has patented, and which he calls chromic acid liquid, consists of bi-chromate of potash, sulphuric acid and chromic acid. He states that with two cups it will raise 1,400 pounds and that adding another cup, it will raise 1,800 pounds. With ten cups, it will raise 5,000 pounds. Mr. Prevost desires this to be discussed and to be examined by scientific men.

Dr. Jerome Kidder.—I suggest that it be tested now, and again in fifteen minutes, to ascertain the difference, and see how much it loses in fifteen minutes.

The cups were connected with the magnet, and the power shown by lifting the heavy magnet by the armature.

Mr. J. K. Fisher inquired what amount of motive power could be produced by this, and how its cost compared with that of other motors.

The President.—The best application of electricity yet made has furnished motive power at about twenty-five times the cost of steam. The difficulty in using electro-magnets upon a large scale has been to free them quickly from magnetic influence; for it is important not only to magnetize but to demagnetize the iron. In large pieces of iron, demagnetization does not take place as readily as in small pieces. Large machines have, therefore, never been found to be as efficient, in proportion to their size, as small machines. If you take a battery of one cup and apply it to a small machine, you get a certain power. Now use fifty cups with a machine fifty times the size, and you will not get fifty times the power, because the soft iron will not demagnetize fast enough to permit the engine to be run at high speed.

Mr. Fisher.—How important is the purity of the iron used in making the magnet? Suppose the iron contains a considerable amount of silica, sulphur or phosphorus, how far does that injure it?

The Chairman.—For the purpose of magnetization and demagnetization, it must be pure, soft iron. The process of demagnetization is just as important as that of magnetization in obtaining power for a machine.

Mr. Dudley Blanchard.—Will the chair inform us what was the result of Mr. Page's experiments in Washington a few years ago.

The President.—They were about as economical as any that have been made. The peculiarity of his plan was, that instead of using rotating magnets or rotating armatures, he simply made a piece of soft iron, enter a helix, operating reciprocally, like the piston of a steam engine. He had a number of these, coupled together in pairs, and they were connected with a crank and balance-wheel, so that the reciprocal motion was changed into a rotary motion.

Mr. Fisher.—Can you tell me about the value of the platinum required in a battery?

The President.—It is not necessary now to use platinum at all. The Bunsen battery, in which carbon is substituted for platinum is now in general use, the two elements being zinc and carbon, as in the battery before us.

Dr. L. Bradley.—There is a great variety of batteries, and of magnets, and modes of constructing magnets for batteries. I apprehend that in this exhibit the advantage is more in the construction of the magnet than in the superior quality of the battery. This would be a powerful magnet, I apprehend, under two cups of Bunsens' battery, or under two cups of any of the common chromic acid batteries such as are now used in all the telegraph offices. Here is another battery such as I have used, a very powerful battery; and it is such a battery as is used by Mr. McCracken for the electric light which illuminates the sign of the Erie railway. How this magnet of Mr. Prevost is made I do not know. It may be a secret. But one thing I observe about it is, that it does not demagnetize when the circuit is broken; and I would like to know how that is. [Breaking the circuit, the magnet was shown to retain considerable power for several minutes.]

Dr. Bradley here tried the large magnet, the fifteen minutes having nearly expired, and found it to possess less power than at first. In the meantime, Dr. Bradley's question having been translated to Mr. Prevost (who does not speak English), he replied that the iron was not prepared for releasing the magnet.

Dr. Bradley resumed: This has still considerable force. Very soft iron will demagnetize more than this will; but I do not know of any iron that will not exhibit more or less of this phenomenon. That is a very serious objection to electro-magnetic engines for power; for it is just as important, as the chairman remarked just now, to demagnetize suddenly or instantaneously, as to magnetize so.

Now I will try another experiment. I have shown that when the iron is in contact, and the magnetism is established in it, it tends to maintain itself. When the magnetic currents are established, breaking the circuit does not destroy those currents entirely. But if we put the armature at a little distance we shall observe a striking difference. Even insulated by this paper, you observe that it has sufficient power to lift the magnet; but when the circuit is broken, you see that the demagnetization is very complete. Still, there is something of the same persistence in the magnentic currents; and I was sorry to see that there was so much, because it interferes with the value of the apparatus for motive power.

That two cups will maintain a two-horse power, or even a one-man power, I very much doubt. We have no reason to suppose that we can obtain from a battery any more force than is equivalent to the power of the battery minus the friction in the work done. Now, I would like to know more about this magnet. I would like to inquire what there is in here.

The Chairman.—We do not wish to call it out if it is a secret, but the association have adopted the rule not to discuss the merits of an article or process if any part of it is kept secret. We cannot discuss the magnet, since it is all hid from view except the two poles or ends. The question of the battery is, however, before us.

Dr. Bradley.—I examined this liquid pretty carefully when it was on exhibition at the fair of the American Institute, being one of the judges appointed to examine it; and I will read from the report of the judges what we said about it.

“*Liquid for Electric Batteries.*—This being the only article of the kind on exhibition is without rival in order of merit. It is similar to the ordinary chromic acid liquid now generally used. According to the exhibitor's patent it is compounded by the following recipe:

800	grammes	water,
50	“	bichromate of potash,
50	“	sulphuric acid,
2	“	chromic acid,

“We have made tests by the galvanometer to determine the relative strength and durability of this and another liquid composed by Mr. McCracken, and find it fully equal to it. We cannot say that it is essentially better.”

In testing this liquid of Mr. Prevost, and that of Mr. McCracken, I could not test them fairly and fully with the galvanometer. I first put my galvanometer in the circuit with one of them, with a small resistance from a common local magnet (only one or two ohms resistance), and at the end of an hour I noted the strength of the current by the galvanometer, and I noted also, the time when it finally ran down. With that resistance, they ran six or seven hours before they would be considered as run down.

The McCracken liquid is composed by this formula:

1 lb. bichromate of potash,
1 gallon water,
3 lbs. sulphuric acid.

There is a wide difference in these proportions. In the fluid of Mr. McCracken there seems to be a large excess, as compared with the other, of sulphuric acid. That, I suppose, does no harm, and with that exception the proportions are nearly the same.

I have in my possession seven or eight different recipes for making liquid for batteries, and no two of them are alike. Here is that for the old Poggendorff liquid:

3 lbs. bichromate of potash,
4 lbs. concentrated sulphuric acid,
8 lbs. (1 gallon) water.

Dr. Poggendorff, I suppose, was the first introducer of this kind of liquid; and this recipe is very similar to that of Mr. Prevost, although the latter introduces two grammes of the pure chromic acid in 900 grammes of the liquid. The benefit of that can be no more than from an equivalent quantity of bichromate of potash; but it is sufficient to give him a patent; for I do not suppose any one ever used chromic acid in a battery before, because of its cost. What does the chromic acid cost per pound?

Mr. Prevost (through an interpreter).—Four English shillings.

Dr. Bradley.—I should think it would cost more than a dollar a pound. At any rate, its cost is so much more than that of the amount of bichromate of potash required to produce, by its decomposition, the same quantity of chromic acid, that the bichromate of potash is altogether the most economical in practical use. I should not use the chromic acid, although it does no harm. The patent can be founded only on the proportions given in the recipe.

The United States Telegraph Company have this recipe:

5 gallons water,
6 lbs. bichromate of potash,
1 gallon sulphuric acid.

The Western Union Telegraph Company have another. Here is one, the inventor of which is unknown:

18 lbs. water,
1 lb. saturated solution bichromate of potash,
1 lb. sulphuric acid.

Mr. Ogden has another recipe of his own:

9 lbs. bichromate of potash,
40 lbs. sulphuric acid,
7 lbs. water.

Mr. H. J. Newton says that

12 fluid ounces water,
1 " ounce sulphuric acid,
1 ounce by weight bichromate of potash

is the best solution for destroying organic matter.

There are seven or eight of these recipes in use, varying more or less from each other, but all in the neighborhood of the same thing, and all working well. I have never heard any complaint of any of them.

The following paper was then read:

PROPOSED WATER SUPPLY FOR PORTIONS OF HUDSON, ESSEX AND UNION COUNTIES, N. J.

By SAMUEL D. TILLMAN, LL.D.

The recent temporary failure in the supply of water to Jersey City and Hoboken naturally raises the query whether the present plans for obtaining water from the Passaic river will be adequate to the future wants of these rapidly expanding cities, and whether a more feasible method may be substituted. The extraordinary growth of New York is a significant indication of the vast population which, at no very distant day, must occupy the opposite shore of the Hudson river. Having maritime advantages precisely like those of New York, its facilities for inland trade and communication are far superior, since all the great west is at its back, and it already embraces the termini of nearly all the great western and southern lines of railway. Thus far the population has found room on the more elevated portions of the shore, but the time is rapidly approaching when all the low ground between the river and Newark will be required for manufacturing and business purposes. It is quite safe, therefore, to predict that early in the next century, the great American metropolis, which might properly be called Manhattan, will consist of New York, with its two millions, of Brooklyn on one side with its million, and of Bergen on the other, embracing Jersey City, Hoboken, Weehawken, Bergen Point, Elizabeth and Newark, with its million of inhabitants.

On examining the best sources for supplying the water wants of the future Bergen, one is first surprised to find, within forty miles west of the Hudson river, a lake whose surface is 914 feet above that of the river. The area of Lake Hopatcong is 2,800 square acres, and its irregular contour on the map indicates that it nestles among mountains and is the reservoir of an extensive water shed. One of the great engineering feats of the future may be to bring the waters of this lake to the banks of the Hudson, with the whole pressure due to its height, less that required to overcome the friction of its passage through iron pipes. Of course, such a project would be feasible only in carrying out magnificent schemes of ornamentation and in furnishing artificial fountains of altitudes never before equaled. The remains of the water works of ancient Rome, as described by travelers, excite our wonder. Its nine great aqueducts had a total length of 255 miles, and a capacity of daily discharge equal to 50,000,000 cubic feet, yet the water was not conveyed at such height as to produce fountains of extraordinary altitude. The most remarkable ornamental fountains are of modern construction. At Versailles, France, a *jet d'eau* rises to the height of ninety feet, another at St. Cloud to 160 feet. The Peterkoff fountain in Russia is 120 feet, and the Chatsworth in England is said to be 267 feet high. The altitude of the Chatsworth reservoir being only 381 feet, the statement of the height of its water jet is too great, unless the water acquires a velocity near that due to its whole descent before reaching the discharging orifice.

It is generally supposed that the law illustrated by the inverted siphon is applicable to fountains, and that they would rise to the level of their respective reservoirs, were they not impeded by friction at the orifice and through the air; and, in the case of vertical jets, by the weight of the descending water. Early experiments seem to indicate that the heights of jets, rising from water under pressure but almost motionless, are to each other as the square roots of the heights of their reservoirs. Taking an experiment in which a reservoir 133.4 feet high gave a jet of 100 feet as the standard, the Chatsworth fountain would have an altitude of 170 feet, while that from a reservoir 900 feet high would be 261 feet.

In turning to the most important question of supplying water for practical purposes to the residents of the great city, we find that the surplus waters of Lake Hopatcong, as well as those of Rockaway and Pompton rivers, are already monopolized by the Morris Canal and Banking Company for purposes of navigation; and the proposition now submitted is the feasibility of purchasing those waters from the company, or so amending its charter as to allow it to undertake the gigantic enterprise of supplying water to the territory alluded to for domestic uses, and to sell all its real estate not required for this purpose.

On examining the levels of the Morris canal, it will be seen that the canal now approaches to within five miles of the city of Newark, at an elevation of 174 feet above the average level of the Passaic river at that place, and extends westward at the same elevation seventeen and one-half miles; in the course of which it receives, through the Pompton feeder, the waters of Greenwood lake, which has about the same area as Lake Hopatcong. That long level may be made to serve the double purpose of an aqueduct and a reservoir, by widening the canal at numerous places where its waters are higher than the adjoining land. This great aqueduct, in its course from Lake Hopatcong, can be supplied with the pure waters of other mountain streams, and thus provide an ample and unfailing supply to a population of several million. From the terminus alluded to, water could be conveyed by means of its own pressure, in iron pipes, to the distributing reservoirs at Newark and Jersey City. These reservoirs are now supplied by means of pumping engines, from the Passaic river. Before reaching these engines, the river passes through Paterson and other manufacturing towns, receiving the drainage therefrom; and although it is admitted that water has the power of freeing itself to a certain extent from ordinary impurities, we must not overlook the fact that water is a solvent of a vast number of chemical compounds which cannot be eradicated by mechanical means.

As the proposed plan for the future water supply of places named cannot be carried into effect without the consent of the Morris Canal Company, the following considerations may have some influence in securing the favorable action of its stockholders.

1. The actual cost of the Morris canal was over $5,000,000. It was purchased and repaired by the present reorganized company, at an expense of about $3,400,000, the paid-up capital stock being $2,200,000. The business of the company has been faithfully and economically managed, yet its profits, after paying the interest on a debt of $1,150,000, only warranted for the year 1869, a dividend of five per cent on $1,175,000, of preferred stock, but no dividend on $1,025,000 of consolidated stock. The principal business of the canal has been the transportation of iron ore and mineral coal; and although the tonnage of iron ore has gradually increased, that of coal, during the years 1868–9, was about the same as for the year 1859, and only two-thirds of the whole amount of coal lately shipped has been carried to tide-water. This brief statement is sufficient to show that the Morris Canal Company is probably ready to entertain propositions which, if accepted would give increased value to its stock.

2. If the canal company should consent to sell that portion of its real estate and water rights, which would be required in the construction of the proposed water-works, its remaining lands and water rights east of the long level could be readily sold at their full value.

3. That portion of the Morris canal within the limits of Jersey City, is now too valuable to be used for purposes of inland navigation. The city should purchase it, deepen it and connect it with a similar canal to be made toward the north and just below Bergen Hill, and use the whole for sewage purposes. It should be covered and converted into a grand highway in the same manner as was Canal street, in the city of New York.

4. That portion of the canal passing from Newark bay through Bergen Hill might be sold to a company who would deepen it and carry it directly east into the Bay of New York, and make a short water communication for vessels of light draft between Newark and New York, thus obviating the necessity of passing southward around Bergen Point.

5. The last but most important consideration relates to the manner in which the Morris Canal Company may make the remaining proportion of their canal more efficient than at present. By its numerous inclined planes, boats are now carried to great heights with greater rapidity than by the use of locks alone. This plan is made feasible by constructing the boat in two sections, each about forty feet long and ten feet wide, which are separately elevated on railway trucks. As a novel and practical system of lifting and lowering vessels, these plans have elicited the approval of the best engineers of the world. The company may see fit to take a still bolder step by using the locks and planes west of Stanhope, for elevating boats 702 feet above the level of the Delaware, from which point they can be transferred to suitable trucks and carried, by the Morris and Essex or other railway, directly to tide-water. The descent of 842 feet greatly favoring their speed, the present number of boats would be increased in efficiency three or four fold. Another feasible plan is to construct a railway on the towing path of the canal west of Stanhope, and use the inclined planes for elevating trains of cars loaded with coal, which could be moved from Stanhope east on the Morris and Essex railway.

In conclusion, a word should be said to the public interested, regarding the propriety of making so large an investment as the purchase of the Morris Canal water rights, although the amount required would be small, compared with the cost of the Croton and other aqueducts.

It may be doubted whether there is true economy in the course now generally adopted of making provisions to supply water only for a single generation, because when a rapid increase in population makes it quite apparent that additional supplies will soon be required, the sources of supply are found to be monopolized, or held at exorbitant prices; and the same conditions occur in regard to the price of lands required for conduits and reservoirs. Just as Newark puts in operation her new pumping engines, Jersey City takes measures for the construction of another reservoir on land which has risen rapidly in value. New York is also moving in favor of increased water facilities, which will cost far more now than they would if secured at the outset. It is possible for New York to bring within her reach at the altitude of the Croton, a supply from a much larger water-shed than it now has; but the city of Brooklyn being higher than the general level of Long Island, will always be compelled to raise her supply by means of pumping engines; and however economical this method of filling reservoirs may be proved, it is certain a city thus supplied will never be prodigal in the use of water.

The residents of Hudson county, and the eastern portions of Essex and Union counties, will be most fortunate if they can secure the canal from near Newark to Lake Hopatcong, and the feeder connected with Lake Greenwood, thereby controlling water-courses having a total length of nearly 100 miles. Should the whole available area alluded to be covered with buildings, each would then have its full quota of water. From its abundance every vessel in the harbor could be supplied, and every stationary steam boiler be fed. It would find its way everywhere for the extinguishment of fires, and leap upward in the form of fountains to adorn parks, public gardens, and boulevards yet to be. We require but little foresight to prognosticate the future commercial greatness of Hudson county. Its eastern portion has been sadly marred by narrow and disjointed streets; being, in fact, a patch-work of villages, each of which was laid out to suit its own landowners. Although it is too late to provide broad and continuous avenues, which would have doubled the present value of city lots, the want of these may be more than counterbalanced by the introduction of water on such a grand scale as to secure for such lots superior sanitary advantages. The public authorities conferring this lasting benefit, will be duly honored by coming generations, who will point with pride to the magnificent water-works and gigantic *jets d'eau* of New Jersey.

Mr. Boyle.—At Cincinnati they pump the water from the Ohio river to the top of one of the hills near the city. The steam-engines are very costly, and the pumping is a perpetual cost. It always seemed to me that it would have been better to bring the water forty miles, rather than have the perpetual cost of those engines.

The President.—It is found in some cases that the interest of the money it would cost to bring water in closed pipes for the necessary distance, would more than pay for running the engines. In other cases it is impossible to find water at the proper level. In Brooklyn, for instance, the water must be pumped up, for there is no other way to get it. In New York we have the Croton lake, which will give us a supply for years to come, although finally it will be insufficient. On the other side of the river, they have not only the lakes referred to, but a dozen streams which can be used. Of course, water can be brought across to New York city by subterranean pipes. Prof. Chandler, in his recent lecture before the American Institute, gave us an analysis of water used in large cities, and also an analysis of the water of the Passaic river, which is nearly as pure as the Croton water, although it is liable to be rendered impure at any time. Should the dyeing establishments at Paterson and other places discharge their refuse salts into the river directly or indirectly, the water would dissolve them, and they could not be taken out by any mechanical means.

Mr. Fisher I recollect that, some years ago, some English towns were in great trouble from the pollution of the rivers by the sewers, and the fish were driven away by the impurities of the stream. It was finally resolved to improve the sewers, so that they should carry off the refuse more quickly, and the fish then returned to the river. It seems that when the drainage for a town is sluggish, a putrefaction takes place which repels the fish.

Mr. Boyle.—In the Adirondacs there is a class of fishermen that catch the trout by throwing chloride of lime into the streams, and catch the dead trout. I saw a stream which was entirely cleared of trout by throwing in a piece not larger than my two hands.

COMPRESSED AIR RAILWAY CAR.

By Mr. J. K. Fisher.

The proposal of Mr. Horace Day to apply the system of working by compressed air, as practiced in the Mont Cenis tunnel, to transfer power from water-falls to places at considerable distances, revives the old idea of using compressed air instead of steam for locomotion. Even if the general opinion be well founded that steam directly applied is cheaper than steam applied to compress air into a reservoir on a locomotive, which air is to drive the locomotive, it still may be economical to work by compressed air, if part of the air can be compressed by a power cheaper than steam. If, on a route of 100 miles, three-quarters of the compressing stations can be supplied by water power that now runs to waste, and one-quarter must be supplied by steam, the aggregate cost may be less than that of steam locomotives for the whole route.

But in some cases the cost is not the governing consideration. On a tunnel railway the impurity of the air, which would be caused by steam locomotives, is a nuisance to be avoided, even at much extra cost for motive power. And even in open streets, it is apprehended by many, the gases and vapors from locomotives would be so unpleasant as to warrant the greater cost of indirect working by steam. I do not believe in this imagined offensiveness of steam from engines that burn good coke and keep their steam so dry as to be invisible, in all weathers when the breath of animals is invisible; but I am one of a minority, and I see that it is politic to propose what is second best, if that be neceesary to avoid the objections of the majority. I therefore present the view that compressed air may be the best available motor for street railways. Though it be deemed much dearer than steam, it will, on full consideration, be deemed much cheaper than horse power, by a majority of engineers, and by those who have the prudence to decide by the evidence of experts, rather than to judge for themselves, without having sufficient knowledge of the subject.

But, as I before said, cost is not the chief consideration. Were compressed air considerably dearer than horse power, it still would be preferable, for several reasons. First, for its cleanliness; a car driven by it would make no dirt; but the horses of a street rail car make 199 pounds of dirt per day. Second, there is a degree of cruelty in wearing out horses in three years, which is painful to humane persons, and brutalizing to the thoughtless.

Sir Joseph Whitworth, with equal humanity and good taste, and with his well-known judgment as a mechanical engineer, thus spoke on these points in an address to the association of foremen engineers: "The use of horse tramways is being urgently pressed forward, and a large outlay is contemplated. In my opinion they are not suited to the present times; and mechanical engineers have a right to enter their protest, considering the many obstructions there have been for many years past to the employment of road locomotives. If toll gates were abolished, and each county had an organized staff for making and keeping the roads, using the steam roller, steam sweeping machine, and other necessary appliances where there is large traffic, mechanical engineers would then, I have no doubt, soon produce a small light locomotive that would do its work quietly and most effectively. At the same time, pedestrians, and those who ride and drive, would have the great enjoyment of good and clean roads, instead of the badly paved and rough Macadam roads. The broken stones of the latter are left for the horses' feet and narrow wheels to consolidate, in a way which it is quite distressing to see. The consumption of fuel per horse power is now so small that road locomotives could be employed at far less expense than the over-worked and ill-conditioned horses we now see; while pedestrians, and those who keep horses for pleasure, would have good roads; and many gentlemen, no doubt, would have their well-made locomotives. Under any circumstances, good clean roads are the most profitable, when everything is taken into account."

To inflict on horses such suffering as they endure in city omnibus and railway service, to keep them in the loathsome air of their underground stables, and work them up to the extreme estimate of profit, is inexcusable at a time when engineers give such opinions as this. And to inflict such dirt on the public is an outrage that cannot be adequately condemned in language suitable for this place. And to endure such outrage is inconsistent with the popular conceit that people are capable of governing themselves. Do the people of this city endure it willingly? or because the politicians, for their own benefit, impose it upon them, or neglect to relieve them from it?

If, then, the majority object to steam, and doubt the cheapness of compressed air, it still is reasonable to claim that the avoidance of these evils is worth paying for at a cost greater than any estimate I have seen. But it is not admitted, by men who have experimented with compressed air, that it would cost more than steam; on the contrary, they claim that it would cost less, and have urged its use in locomotives. They claim that stationary engines, working with greater economy than locomotives, can compress air to drive them at less than the cost of the boilers, fuel, repairs and attendance, now adopted on railways. I have, on a committee of this club, joined in showing that a compressed air locomotive cannot run more than twenty miles with one charge of air, and is therefore unfit for common railway service; but for three-mile trips the case is different. I have carefully computed the weight of this plan, and compared it with the weight of a steam car; and it seems to me that it will be lighter than a steam car, and will run four or five miles with one charge. If it will do this, it will work as cheaply as steam on a short railway. Denying, then, the current affirmations that compressed air is too dear, and steam is somehow objectionable, I say that if these affirmations were true, it would still be advantageous to try them both, and adopt the best of the two.

But who will establish this old invention, whose patents expired before machine-shops could build it half as cheaply as it can now be built? Who will demonstrate, at a cost of $5,000, or $10,000, or $15,000, to build one, or two, or three cars, that this invention is sound, while others are free to compete with him? Nathaniel

Ogle, when asked, by a committee of the Commons, a like question respecting steam carriages, said that if some gentleman should think well of the invention, and give 20,000 pounds to promote it, and apply that money judiciously, he had no doubt the invention could be established, provided the tolls were made equal to those on horse carriages of equal capacity. So I say. If some gentleman, for the public good and his own fame, would take up this invention now, and build a car and try it, and find out its defects; and build another with improvements, and then another and another, with further improvements, he would, at less cost than would have been necessary in that early period in the locomotive art, show that the invention can work at less than the cost of horses, and be safe and agreeable to the public. And then, no doubt, the street railway companies would adopt them, and get them from the cheapest builders.

But it is not safe to depend on personal liberality to promote inventions, when we have patent laws for that pupose, even in cases in which those laws have failed of their intended effect. We must therefore seek for something patentable, to give a preference, if not a monopoly, to those who spend time and money to perfect the details and proportions, and excite a demand for such machines.

I have attempted, in this design of a city railway car, to devise an improvement, on which a patent can be founded. What I have done is, to modify the method of warming and heating the air. Other ways of heating it have been patented, by Mr. Lemuel Wright, whom we saw here at our discussion on the communications with Brooklyn; but I have some hope that my method will prove better than his, or any other that I have seen proposed. It consists in using compressed gas, which is jetted into the compressed air, on its way to the engines. It may be ignited by spongy platinum, or by electricity, or by a lamp kept burning in the combustion chamber. There are six air-holders of thirty-seven cubic feet united capacity, which will hold 1,850 feet of air when compressed to fifty times its ordinary density. To heat this air 300°, which I believe is about what is required to prevent freezing when the air expands to atmospheric pressure, will require eleven cubic feet of carburetted hydrogen. The cost may be three cents, but it should be much less, if there were a large demand for it; for this gas is a mere diluter of street gas, giving scarcely any light; and if the gas made in the early part of the process, when the true illuminating gases are not made in much quantity, were turned into a separate main, the amount of light supplied would not be much lessened. For a few experimenting vehicles, this gas would do; but where there are many, it may be expedient to make a cheaper kind of gas, such as was proposed at Berlin, two years ago. They were to make gas from lignite, at the mines; and to send it thirty miles through tubes, and sell it to the consumers at sixpence per 1,000 feet. I do not know the heating powers of it; but it was computed that it would be cheaper than coal, for domestic heating. In tunnels, pure hydrogen will be required, because it makes no poisonous gas to contaminate the air.

It may be recollected that I proposed, in the discussion on Mr. Day's project, to use a cheap gas instead of air, to be compressed, and to ignite a part of it as it issues from the engines, and direct the flame against pipes through which the air or gas passes on its way to the engine. A small part of the compressed fluid may be gas, and the greater part air; one of the six vessels, filled with a mixture of gas and air, would give sufficient heat. But I think, after further examination that the apparatus will be cheaper and lighter if made to burn the gas in the way shown in the drawing, that is, just as we burn it for lighting, in the air.

It will appear to some, as it appeared to me, that it will be difficult to control the flow of gas into the combustion chamber, so as to keep the jets lighted when the car stops to take up passengers. I think it can be done by a large chamber and jets, so contrived that the pressure in the gas reservoir shall be greater than in the air reservoirs. If not, there are other means, not necessary to discuss at this time.

I need not now discuss the main item of cost, the compression of the air. That has been practically treated, in England and here, and has been proclaimed successful, or, at least, not mechanically difficult. In Chicago and New Orleans, and on our famous elevated railway, it has been recently tried with alleged success. It has been abandoned here, for what reason I have not heard. But the freezing, and the loss of power consequent on the loss of heat by compression probably will always render impracticable the working of cars by compressed air, without some means of restoring part of the heat.

It may be required that I should assign my reasons for supposing that 300° of heat will restore the elasticity of the air, compressed to fifty atmospheres. I confess that I am not able to give a satisfactory reason for it. I am not satisfied with the theories, and deductions from experiments which I have found in the books; they do not accord with each other, or with appearances which I have witnessed. I therefore have ventured to take the analogy of steam. If you compress steam to fifty atmospheres pressure, you will raise its temperature 298°; and I think it safer to assume that air will confirm nearly to this law, than to trust to the imperfect experiments and theories I have seen recorded.

A brief comparison of the mechanical effects of heat, when applied to making and to superheating steam, may help to show the economy of heat applied as I propose.

To make a pound of steam, from water at 60°, at the usual locomotive pressure, requires 1,170 units of heat. To superheat a pound of steam 490°, which doubles its volume, requires 233 units of heat. Thus, to double the power of the steam, requires a little less than a fifth of the heat required to make it. And it is nearly as economical to apply heat to air; Rankine holds that equal quantities of heat will produce equal power, whatever elastic fluids they act upon.

It is further to be observed that there need be no waste of heat, when the gas is burnt *in* the air; whereas a third of the heat goes away in the smoke, in locomotives. Considered as a nuisance, in streets and in tunnels, the heat and foul gases, made in this way, would be scarcely perceptible; whereas in a continuous tunnel, such as is proposed here, the gases from a locomotive would be destructive to health. In the London underground railway, which is a third in open cuttings, the engines close their dampers in the tunnels, and do their firing in the cuttings; yet the gases in the tunnels have been much complained of.

Whether this method of heating compressed air, for this use, will give a sufficient commercial advantage to warrant an investment of money to establish what has been called compressed air locomotion, is a question which I should like to decide for others, if they would allow me; but as each will probably decide for himself, before he risks the money, I will not attempt to decide for him.

One thing, however, I will say, as a retort upon those who call it visionary to propose steam carriages, and who advocate the underground railway schemes that are now before the inexpert legislators at Albany, and urge that they be built, if not by private capital alone, then by subsidies from the city. I say they are visionaries. I say that the Metropolitan railway, of London, referred to as a profitable work, is unprofitable. I say that they have been guilty of culpable reticence, in not informing the public of this city of the true financial condition of that company; I have not seen, in a New York journal, a true report of its divends, or the price of its stock, since the stock was selling at 130 or thereabout, and dividends of seven per cent were made mainly out of capital. On the contrary, a few days ago a leading promoter of these schemes in the legislature told me that the stock of the Metropolitan was selling at 107, and a leading journal said the work was highly profitable; whereas the London *Economist* reports the stock at 66¾ and the last dividend at 3¼. I should be glad to hear one in this audience say if he has seen in any New York paper a quotation of this stock or its dividends at so low a rate. Nor have I seen in the English engineering journals any fair exposure of the deception founded on the early reports about this railway; those journals live on the engineering profession, and are silent about its errors, and loud in its praise I do not imagine that they are bribed; nor do I imagine that the journals here are corruptly influenced; but there is in them a disinclination to report what may discourage capitalists from taking stock in these schemes, and an inclination to allow them to spend their money for the public good, without a reasonable chance of profit to themselves. Intelligent capitalists will not be caught; but speculators will puff and sell the stock to people of small means and great hopes, and it will be as bad for them as downright swindling could be. They will lose their money, if this scheme be carried out by private capital; and, unless the journals of this city are calumniators, there is likely to be immense robbery of the tax-payers, if they be carried out by help of city bonds, as is now urged by the West Side Association and by some of the journals.

Nor is the prototype of these schemes well planned for its present work; nor was it planned at all for this work. It was planned to bring one of the great railways into the heart of London; and little was expected of it in the way of city passenger traffic. It would have been a signal blunder had it been designed for its present use; for it was so ill-suited to it that it had to be widened in some parts; and is still so ill-suited that the best engineering journal speculated about improvements on it that would involve almost a reconstruction. But, bad as it is, its imitations here are worse, since they are to be in a continuous tunnel, with no ventilation but through fourteen inch lamp-posts, or the areas under windows. Mr. Robert Fairlie, who is distinguished as the inventor of a duplex locomotive, being asked what he thought of these plans, said we had better go above ground.

I touch upon these schemes now, not to make them part of my subject, but to get them out of the way of better schemes; or, rather, to warn those who get their information from sources in this market, that they are being misinformed, and had better look to original sources for it.

As for street railways, I am, as I have been for many years, and as Whitworth is, of opinion that they are not suited to the present times; but they may be made better by putting on them steam cars, or air cars, if they be preferred. Their average speed may be doubled, without making them more dangerous than they are now. And this would increase the average speed of the whole passenger traffic more than it can be increased by the tunnel lines proposed, while the surface traffic is by horse power. The key, and economical commencement of this improvement, is the introduction of locomotives on common roads, on which carriages will be independent of each other, and can run their whole trips without stopping.

In this paper I have used some language that may seem harsh. I used it for the purpose of provoking a discussion with some of the advocates of these schemes. I am ready to maintain these propositions:

1st. That railways with stations five-eighths of a mile apart are incapable of half the average speed attainable by the system I propose.

2d. That the horse is an unmitigated nuisance in cities; he is the direct and indirect cause of all the dirt in streets, and is the unsafest motor in use, and is intolerably slow, and has not the merit of cheapness to atone for these evils. Moreover, there cannot be good, cleanly and economical roads until horse power is superseded. If persons of natural and somewhat barbarous tastes, like horses as they like dogs, and wish to use them for pleasure, I shall not contend with them, unless they oppose the use of steam, and the adaptation of roads to wheels. What I wish to discuss is the utilitarian question of carrying people who ride for business purposes. If any one is disposed to engage in *writing* a discussion, with a view to publish it, if it be satisfactorily written, I shall be glad to hear from him. And if any one is inclined to join in perfecting this invention, or in constructing it, I shall also be glad to hear from him.

Adjourned.

February 23, 1871.

Professor S. D. Tillman in the chair; Robert Weir, Esq., Secretary.

Invalid Bedstead.

Mr. T. McIlroy exhibited and explained a model of his invalid's bedstead. In heart disease, asthma, consumption and dropsy, we require an elevation of the head; and by turning a handle, we may lift the head to any desired elevation, by raising the upper half of the horizontal frame-work, turning upon an angle at the center. But this is not usually all that is required, because there will be a tendency for the patient to slip down in the bed. This is counteracted by raising the width of the lower half of the same frame-work at the knee, forming a "double incline," particularly useful for persons troubled with rheumatism, paralysis, or spinal complaint. To accommodate the seat thus provided to the length of the femur of persons of different heights, there is a movable slab at the knee. He also described the use of the same bedstead in cases of fracture, and his appliances for the reduction of fracture, and to prevent the limb from rotating. The lower part of the bedstead may be raised, and a footboard is provided, which may be turned over to serve as a table.

The Chairman stated that he regarded this as a valuable invention. He had lately sent one to a friend residing in Wilmington, N. C., afflicted with inflammatory rheumatism, and had just received a letter from this friend stating that the use of Mr. McIlroy's invention greatly alleviated his sufferings.

A NEW FORM OF MAGIC LANTERN.

Henry. Morton, Ph. D., President of the Stevens Institute of Technology, Hoboken, N. J., addressed the association as follows:

"*Mr. President and Gentlemen of the Polytechnic Section.*—The apparatus to which I take the liberty of calling your attention for a few minutes this evening, owes its general plan and optical arrangement to Prof. J. P. Cooke, of Cambridge, Mass. My own work in connection with it has been to devise such a mechanical adjustment of parts, and such small details as, while too insignificant individually to merit special notice, nevertheless add somewhat to the general convenience in use and efficiency of the instrument.

The idea of throwing images, from horizontal objects, on a screen is far from a new one. Faraday and Tyndall, so projected the image of the magnetic spectrum by employing an electric lantern, turned over on its back, and in connection with the experiment of the illuminated fountain described in the journal of the Franklin Institute Vol. 58, page 358. I had repeated the same thing with a lime light, during the winter of 1867–8, employing the same arrangement of the lantern that was used in the fountain.

In 1869, Mr. C. J. Woodward described* a like arrangement for projecting images of cohesion figures on the ceiling, and suggested the use of a square prism for throwing them on the screen. This plan, however, I had already tried and found open to the serious objection that about one-third of the rays entering the prism were not at the angle of total reflection, and therefore did not pass to the screen; thus leaving a notable part of the field dark.

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* Chemical News, Vol. 19, page 21.

During a visit to Cambridge, Mass., last summer, Prof Cooke, of Harvard College, was kind enough to show me a lantern in operation, in which the light, as it passed from the condensers, was received on a mirror at an angle of 45°, by which it was thrown upward through the horizontal object and object-glass, and was then directed to the screen by a silvered glass mirror.

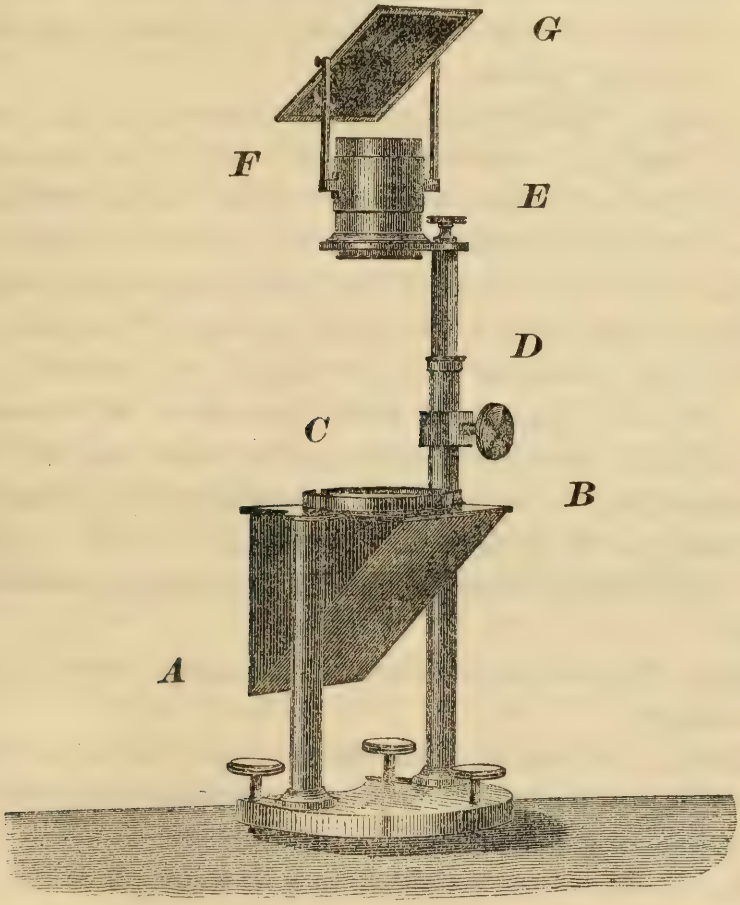
Prof. Cooke has since informed me that he had at that time also tried the effect of separating the elements of the condenser, in the manner to be presently described; but for reasons connected with his own apparatus and requirements, had not thought it desirable to adopt that arrangement for his own general use. With the instrument above described, Prof. Cooke showed me the very beautiful experiments he had devised in which waves in circular and eliptical tanks were projected on the screen.

Strongly impressed with the capacity of this means of illustration, I took the first opportunity to prepare drawings from which the instrument before you was constructed, by Messrs. Hawkins & Wale, with an accuracy of workmanship which does them the greatest credit.

Its general arrangement will be readily understood by aid of the accompanying sketch, and a very brief description.

The lantern condensers, made long before and used also for other purposes, consisted of three lenses, the first two being of such curve as to give a practically parallel beam with the light at about two inches from the nearest surface. The object of this is to bring the plane of the object as close as possible to the front surface of the condensers. In front of these lenses came the first mirror A B at an angle of forty-five degrees. By this, the parallel beam was thrown vertically upward on the third lens of the condenser, placed horizontally at C, and immediately on this rested the object; or when this object was to be a tank of water, the lens at C was made the bottom of the tank by being set in a brass ring fitting water-tight. The object-glass was carried in the tube shown between E and F, and the mirror for reflecting the image to the screen was at F G, all this part being adjustable by sliding and by a rack and pinion at D."

The apparatus was then put in operation, being illuminated with the lime light, and there was first shown a magnetic spectrum, prepared and fixed on glass by an ingenious process devised by Professor A. M. Mayer. This showed the sharpest definition that could be desired. Iron filings being then evenly scattered over a plate of glass, a small steel magnet was placed beneath, and the glass lightly tapped with a pencil point, when the filings were seen to fall into rank, and to arrange themselves in the graceful inflections of the magnetic curves. A tank of water was next introduced, and by means of an ingenious contrivance devised by Messrs. Hawkins and Wale, series of waves were developed, and their reflections from the sides of the tank, interferences, and other phenomena, were beautifully exhibited. The apparatus for producing the waves consisted of a metallic box with a sheet rubber cover, provided with a long thin metal tube; this was so placed that the tube was about one-quarter of an inch above the point in the tank which it was desired to make the center of the wave motion. On tapping the rubber diaphragm a momentary puff of air was driven from the tube, producing exactly the disturbance needed. An eliptical ring being placed in the tank,



the properties of that curve with regard to reflection, were very neatly exhibited, and in fact independent of their scientific interest, nothing could be more charming than the pearl gray waves crossing and interlocking and combining in complex patterns, which raced across the screen.

The beautiful cohesion figures produced by dropping various oils on the surface of water, first studied by Tomlinson, were then exhibited with marked effect, as also the motions of fragments of camphor on perfectly clean water. The oils which produce the most beautiful figures are those of coriander and cinnamon; carbolic acid in strong solution acts in a very curious manner, and alcohol and ether give likewise very pretty figures.

Lastly, a large Chladni plate of glass, clamped at the center, was so supported that one corner occupied the field of the lantern; on this corner was cemented a shallow ring of rubber which confined a little pool of water about one-tenth inch deep. When a violin bow was drawn across the outer edge of the plate, the entire field on the screen was covered with a beautiful pattern of crispations, which varied with each change of tone developed by variously damping the plate. Shallow glass tanks with rings of tin wire around their borders, and platinum wires touching at a point near the center of the tank containing chloride of tin, connected with a galvanic battery, showed a fine growth of metallic vegetation.

At the conclusion of these interesting experiments, some questions were asked.

Mr. Robert Weir.—Can you throw a photograph upon the wall with this instrument?

Prof. Morton.—Certainly; but there would be no advantage in using the mirror in that case. For such purposes the ordinary form of magic lantern can be used.

Prof. Morton illustrated by showing a photograph of the late solar eclipse, taken by the American party. The corona and prominences were visible, but the latter, on account of the haze in the atmosphere, produced by the diffusion of their light apparent indentations in the sun's limb, and their form was not well shown.

Mr. Weir.—I see that during the war, the London *Times* was photographed on small sheets, and sent by carrier pigeons to Paris, where they were illuminated and thrown upon a wall, so that they could be read. How could that be done?

Prof. Morton.—On the principle of the magascope, in which the light is thrown upon an opaque object, and is reflected from it, forming an image upon the screen. It is a photographer's camera turned wrong side out. It would not be useful except for opaque objects. The photographs may have been taken on transparent paper, and then the image formed in the usual way.

Mr. Weir.—I understood that they were photographed on ordinary paper.

Prof. Morton.—It is very likely that they took a second photograph on glass, and that that was projected upon the screen in the usual way.

A Member.—Has it been shown by this last eclipse that the light we see around the sun in a total eclipse is reflected light?

Prof. Morton.—That was supposed to be the result at a time when they had heard from only a few of the observers; but some of the American observers, Prof. Winlock, Young and others, were able to observe the green line in the spectrum, at the distance of sixteen degrees, or even twenty degrees from the sun, and this could not have been produced by reflected light. The line in the green which they saw is not in the ordinary sunlight. It is seen in the aurora, and has been noticed under peculiar conditions in other conical light. It was noticed in the previous eclipse in our own country by Prof. Young. That showed that there was light which was not a reflection from the earth's atmosphere merely; but that a portion of the light was reflected, was proved by observations with the polariscope, made by Prof. Pickering and others, which showed that there was light polarized in rays which radiated from the sun's center, and which was therefore reflected light, and quite likely reflected by the earth's atmosphere. Yet the question is by no means settled by this eclipse. The probability is that it is a composite phenomenon; that a portion of the light is reflected by luminous matter surrounding the sun, another portion by non-luminous matter about the sun, and still another portion by our own atmosphere.

ON HIGH SPEED OF PISTONS.

In a paper with this title Mr. Dudley Blanchard took exception to the positions advanced by Mr. Charles T. Porter, on high speed pistons, at a recent meeting. The difference of opinion was chiefly the result of a misconception of the terms used by Mr Porter.

Mr. Blanchard endeavored to make his position clear by the following illustration: Let the fly-wheel of a steam-engine, which is nothing more or less than a reservoir of power, be represented by a reservoir of water, into which that fluid is being pumped by a succession of intermittent impulses, in the usual manner. In this case each impulse of the pump makes but little comparative difference in the amount of water accumulated in the reservoir, therefore a steady and continuous stream may flow from the reservoir. Now, if we place between this reservoir and the pump a smaller reservoir, connected with each, and so arranged that it shall fill itself from the pump and discharge itself into the large reservoir at each stroke of the pump, then we shall have the action of the steam-engine, so far as relates to the momentum accumulating in the piston, fairly represented. This smaller reservoir, which is to empty and fill itself at each intermittent impulse of the pump, represents the capacity for momentum in the piston of the steam-engine. It takes a certain amount of power at the beginning of the stroke, to put the piston in motion, on account of the resistance of its inertia, but this power is given off to the fly-wheel toward the end of the stroke, minus the friction, so that nothing is gained or lost but the power required to overcome the friction. Now, all the arguments and calculations designed to show that the momentum of the piston is a source of gain, could be applied to my sub-reservoir to prove that it increases the flow of water.

Mr. Charles B. Boyle illustrated upon the blackboard the problem of falling bodies, in connection with the motion of the piston of a steam-engine. The first application of the law of falling bodies, by Newton, was to the motion of the moon. It is assumed that in the motion of the moon in its orbit, the first impulse of motion would be in a straight line. That is a mere idea which cannot be proved. We merely accept it on faith. The attraction of gravitation drawing the moon into the circle, draws it down by an amount equal to the versed sine of the arc; and so the motion of the piston of the steam-engine agrees with the versed sine of the arc of the motion of the crank, and gives us exactly the column of figures which Mr. Porter's article contains. Now, in obtaining the amount of depression in small arcs, the process is to square the distance and divide by the diameter of the circle. The engineer, in leveling, divides by the diameter of the earth; and in case of the moon we divide by the diameter of the moon's orbit. Now the crank of a steam-engine, moving in equal continuous motion, describes equal spaces in equal times, and consequently divides the periphery of the circle into equal parts in equal times, while the piston moves through the diameter with a motion varying according to the versed sine; and that is the entire connection of the motion of falling bodies with this subject. This is simply a question of the properties of a circle, independent of motion. Mr.

Boyle concluded with an illustration of the laws of falling bodies, by exhibiting a leaden and cork ball of equal size, and, therefore, equally resisted by the atmosphere, connected by a wire. Letting them fall to the floor, both strike the floor apparently together; but letting them fall from an altitude of thirty feet or more, the leaden ball invariably strikes first. Such would not be the result, however, if these balls were moving in a perfect vacuum.

Mr. Charles T. Porter said: In any steam-engine, at the middle of the stroke, the reciprocating parts have attained a certain velocity. They have attained that velocity in traversing one-half the stroke. By a very simple calculation we ascertain what force, constantly exerted, will be required to impart to a mass moving through that distance, the velocity actually attained. Although the motion is in a horizontal direction, the acceleration is precisely of the same kind as in vertical motion. Hence, by referring to the law of falling bodies, we see that a simple parallelogram will represent that constantly accelerating force. If the accelerating force were uniform during half the stroke, the retarding force must be uniform during the other half of the stroke. But we find that the accelerating force at the commencement of the stroke is doubled, and that at the middle of the stroke it is nothing at all. That is what I asserted, and what the figures I presented proved; and I apprehend that no man, when he comes to understand it, can possibly question it.

Dr. Vanderweyde.—That is on the supposition that the fly-wheel moves uniformly.

Mr. Porter.—Yes, sir.

Dr. Vanderweyde.—Suppose you have not a fly-wheel, but you let the steam push on the piston and turn the crank. Will it not come to a dead stop at the center point?

Mr. Porter.—Without a fly-wheel, the engines would stop at the dead centers, and would not be carried past.

Dr. Vanderweyde.—Then does it not depend on the uniform motion of the wheel?

Mr. Porter.—Yes, it does. But if the piston is obliged to move with that velocity, it must have that accelerating force, no matter whether it is guided by the steam or by a fly-wheel. If it comes to a stop, it does not have that accelerating force applied to it.

Dr. Vanderweyde.—There is no acceleration in the circumference of a circle. If the fly-wheel moves uniformly, you can easily calculate the motion of the piston from the versed sines of the angles; so that it is a property of the circle, as Mr. Boyle attempted to prove.

Mr. Porter.—The table of versed sines will show the nature of the acceleration.

Dr. Vanderweyde.—That has nothing to do with the steam-engine.

Mr. Porter.—I think it has everything to do with the steam-engine.

Dr. Vanderweyde.—It is a general property.

Mr. Porter.—If the motion of the piston is controlled by a crank, there is a rotary motion controlling the reciprocating motion of the piston. The action is entirely dependent on the rotary motion. The table of versed sines therefore shows the nature of the acceleration of a piston controlled by a crank supposed to be moving uniformly. That is the simple fact I endeavored to state; and I do not think it can be questioned.

Mr. Blanchard.—Don't you state that the acceleration is absolutely the greatest in the center.

Mr. Porter.—Yes, sir.

Mr. Blanchard.—Then it is the greatest when the piston stands perfectly still.

Mr. Porter.—If the gentleman will oblige me by calling at my works in Harlem, I will show him a little engine with the braces of the connecting-rod quite loose. Start the engine, and it will go very hard. At full speed the engine runs in perfect silence, showing that a crank passes the center under a strain, a centrifugal strain from the piston, greater than the force of the steam applied on the other side of the piston is able to overcome; demonstrating practically and beautifully that the acceleration is greatest on the dead center; not before motion begins to be imparted, but where it begins to be imparted.

Dr. Vanderweyde.—The motion of what?

Mr. Porter.—The motion of the piston.

Dr. Vanderweyde.—The piston stands still.

Mr. Porter.—The piston has gained a certain velocity at the middle of the stroke, by continual acceleration. That acceleration must have a beginning, and the demonstration is that where it begins, at that precise point, the acceleration is greatest, and that it gradually diminishes until at the middle of the stroke there is no acceleration, and it then passes into retardation.

In conversation with President Barnard, of Columbia College, upon this subject, he made use of a beautiful illustration of the insensible manner in which the rotary motion of the crank becomes, through the connecting-rod, transformed into reciprocating motion in the piston. Every point in the connecting-rod describes an ellipse, more and more elongated as we approach the piston, until it finally passes into a straight line, and we have absolutely rotation in a straight line, which is the motion of the piston.

Dr. Vanderweyde.—I was not present at the reading of your paper, but it appears to me that there is a misunderstanding here. The rate of acceleration, it appears to me, may be greater, but the acceleration itself may be less.

Mr. Porter.—As the velocity of the piston becomes greater the ratio of acceleration diminishes.

Dr. Vanderweyde.—Certainly.

Mr. Blanchard.—I understood the gentleman to claim to have made a great discovery ; but what he has stated to night we all know.

Mr. Porter.—I understood Mr. Blanchard to say that it is impossible to conceive of force without motion.

Mr. Blanchard.—Yes ; it is.

Mr. Porter.—Suppose a fly-wheel is rotated with increasing velocity until it bursts asunder. Was there any force exerted by that fly-wheel before it burst?

Mr. Blanchard.—Certainly. There was motion.

Mr. Porter.—Was there any rending force, any bursting force?

Mr. Blanchard.—There was a force manifested by motion; and without motion a fly-wheel will not burst.

Mr. Porter.—Was there any motion in the direction of the force?

Mr. Blanchard.—There was motion. The direction of it was bent or modified by the cohesion of the mass.

Dr. Vanderweyde.—Every particle was moving in a circle.

Mr. Porter.—Was there motion in the direction of the bursting force?

Dr. Vanderweyde.—That is another matter.

Adjourned.

March 9, 1871.

Prof. S. D. Tillman in the chair; Robert Weir, Esq., Secretary.

Steam Cars for Cities.

Mr. J. K. Fisher exhibited a drawing of a steam carriage, intended to run upon rails in cities. There is a pair of pilot wheels, running in grooves, and the remaining wheels are made about five inches in width, to run upon the track. He requested the opinion of engineers, whether upon an ordinary straight track these wheels would follow the pilot wheels and remain upon the track, or, if they should occasionally run off, whether they would be drawn by the pilot wheels on to the track again. On curves it is intended that the following wheels shall run off the track.

Mr. Robert Weir.—I think the rear wheels will be running off and on all the time. There must be some swinging all the time in the motion, and unless there are flanges, I think they would be likely to be off the rails quite as much as on; yet I would like to see it tried before saying positively.

A member.—If one rail should be higher than the other, the rear wheels would be sure to slide sideways. Rails are more often uneven than even.

Mr. Weir.—You could keep them on by having a pilot at both ends.

Mr. C. O. Read.—I think they will follow the pilot wheels when there is nothing to throw them off; when there is no obstruction.

The President.—If you have only one pair of guiding wheels, any obstruction on one side will tend to throw to the other side the point connected with the rear wheels. It will require two pairs of guiding wheels to keep that point fixed. Early in the history of railways the cars were not placed upon trucks, two pairs of wheels to each truck; and Mr. Wynans, of Baltimore, took out a patent for putting a long car on two four-wheeled trucks. That was found to work admirably, and the patent would have been worth millions if it had been sustained by the courts; but it was decided that he was not the first inventor. On the palace cars, and on many of the new ordinary cars, there is at each end a truck having three pairs of wheels.

Mr. Fisher.—Did you ever know a case when the hind wheels of a wagon did not follow the forward wheels?

Dr. Edwin McCracken.—The driving wheels of a locomotive are made flat, and they follow the guiding wheels.

Dr. Vanderweyde.—In front of a Harlem railroad engine house used to be a curve where they had extra rails to support the driving wheels of the locomotive, which were flat, without flanges, and ran there entirely outside the track.

Dr. McCracken.—I think those wheels would follow right along if there was no impediment in the way.

The President.—True; *if* there were no impediments.

Mr. Fisher.—For the next ten years it is better that we should run on the pavements and on the street rails by steam, than that we should go to the expense of laying rails. These carriages are intended to run on the ordinary street rails; but when there is any obstruction, as in the case of a fire, they can run off the track, and if necessary run around a block. There should be two classes of carriages: one very cheap, in which people should stand up as they do now, and another at a higher fare in which every one should always have a seat. We can run eight and a half miles an hour with steam as safely as we can run six miles an hour with horse power. The whole power of the steam can instantly be applied to stop the cars when necessary. The steam cars could run up the steep grades as rapidly as the law allows, which cannot be done by horses.

Mr. Weir.—Have you made any estimate of the cost of a carriage like that?

Mr. Fisher.—The Novelty Works offered, before the war, to build them for $4,500 apiece.

Mr. Weir.—How does the weight compare with that of the horse cars?

Mr. Fisher.—They would be heavier, by the weight of the machinery and of the portion of the carriage which carries the machinery. For an equal load they would perhaps weigh one-quarter more.

A member.—Why were the steam-engines taken off the Second Avenue road?

Mr. Fisher.—The engines were not properly constructed, and they were too heavy for the track.

Mr. Disturnell.—Have not engines of this kind been before the English public for thirty or forty years? Have they made any improvements in them, or brought them into use?

Mr. Fisher.—There are probably 1,200 of Aveling and Porter's and other's road locomotives at work there to-day for slow transport. The law of road locomotives in England is that their speed shall not exceed two miles an hour in city, and five miles in the country. There are other than mechanical reasons why they have not been more extensively used in England. Mr. F. proceeded to describe improvements in construction which had lately been made, such as the introduction of the link, the use of easy springs, etc.

Electric Time-keeping.

Dr. L. Bradley exhibited his new electric clock, and read the following paper:

Electric time-keeping is a subject which, for the last quarter of a century, has engaged the attention of many profoundly scientific men, among a host of whom I may name, especially, Shepherd, Bain, Dent, Airy and Wheatstone. Much time, labor and money have been expended in efforts, not only to produce primany regulators, to be actuated by electric force, but to devise modes of telegraphing time through lines of secondary dials, by electric impulses sent through the line from a galvanic battery, contacts being automatically established and interrupted by some device in the primary regulator, by which they are caused to move synchronously with it.

I may say that all such efforts have hitherto proved ineffectual. All prime movers have been found to vary more or less, according to the ever varying condition and strength of the moving force. Every change in the condition of the battery elements, as well as in the temperature, changes the power of the battery in some degree, and every change in that power changes the rate of the time-keeper moved by it.

A more serious difficulty has been encountered in the employment of oscillating or ticking clocks for opening and closing circuits of secondary dials. Anything short of substantial and firm closings are liable either to fail of contact, or to make double or triple touches, and are therefore unreliable. No oscillating pendulum can be made to move with power sufficient to overcome the resistance offered by such firm closings. Contacts in mercury do not answer, for the reason that the metallic points dipping into it soon become coated with an insulating film, causing failure. Even firm contacts by single platinum points are liable to fail, on account of the corroding effect of the spark usually visible on breaking circuit.

In the system which I have the honor here to present, all the aforementioned difficulties are avoided; modes entirely new are so combined and arranged as to present a complete whole, capable of fulfilling the object so long sought.

The primary regulator is moved by a weight, which is undeniably the most uniform and persistent propelling power of any. The conical or gyral pendulum (mercurially compensated) is employed, in which there is a constant store of force, acting as a retaining power, amply sufficient for overcoming all necessary resistance in firmly closing circuit and for carrying the movement forward while winding the clock. Instead of a single platinum point for closing circuit, two or more are used. I employ four, placed on four springs, all closing at the same instant, on a horizontal platinum bar. The current being thus divided among them, the quantity for each is so small that no corroding spark is visible.

An arm on the second-hand shaft of the primary, at every revolution, tips a lever, which brings the platinum points of the springs in contact with the platinum bar, which closes circuit through the line of secondaries. In each secondary an electro-magnet is so actuated as to carry forward, by means of pawls, a sixty-toothed wheel, which carries the minute-hand shaft, the wheel being moved one tooth at each closing; the minute-hand, therefore, performs one revolution every hour, and the hour-hand is carried by the ordinary arrangement of face wheels.

The circuit being thus closed only once every minute, and then only for a second or two at a time, the expenditure of battery power is limited to that of, say one-thirtieth the amount supervening where circuit is closed every second.

This system has been in operation in Wall, Broad and New streets, New York, for about six months; a primary at the brokers' board room and some fifteen secondaries in as many brokers' offices; and with the exception of a few mishaps, such as are incidental to the development and first introduction of all new inventions, it has run with perfect regularity, and has given entire satisfaction to all concerned.

Dr. Bradley also exhibited his primary clock, with a secondary dial. Ordinarily, in sulphate of copper batteries the liquid rises by capillary attraction on the interior surface of the glass cell, and then dries and crystallizes. By pouring a film of oil on the top of the liquid, the cell may be kept for months clean and free from crystallization.

In describing the gyral pendulum he stated that it possessed a store of force, so that in winding the clock, even if a whole minute should be occupied, there would be not a second of time lost. The pendulum has a mercurial compensation. In ordinary mercurial compensation pendulums the column of mercury is not long enough.

Dr. Vanderweyde stated that the height of mercury necessary for compensation could be computed with accuracy, and referred to a clock for which he had computed the amount of mercury required, and which has since run twenty years without changing.

Dr. Bradley remarked that he had observed that when there was weight enough applied to make the pendulum swing in a large circle the clock ran faster than when it was swinging in a small circle.

Dr. Vanderweyde.—I am surprised at that; for in a common clock it is the other way. If you give the oscillations of a vibrating pendulum greater amplitude the clock goes slower.

Dr. Bradley.—It surprised me; but I found it to be so.

The President silently drew upon the black-board a representation of the pendulum at two different distances from the center, showing that when revolving in a large circle it is vertically shorter.

Dr. Vanderweyde.—I think the cause is, that the greater power required to make the pendulum deviate so far from the axis of gyration overbalances the tendency it would otherwise have to go slower You will remember the experiments of Foucault to demonstrate the rotation of the earth by means of a very long pendulum. That pendulum has a great tendency to go into a gyration. When it describes an ellipse that ellipse will shift its position, owing to the rotation of the earth. I found in experimenting with it that it could be made to go in a circle. That pendulum would go slower in a large circle than in a small circle. But in this case it is not a constant power that drives it. You add to the power, driving it farther from the center; as the power is increased the circle is larger; and if the power were infinite the pendulum would rotate in a horizontal plane. But the power is increased in a greater ratio than the size of the circle, and therefore I see that it must go faster.

Mr. Fisher.—The question of centrifugal force must have something to do with the phenomenon. I think the solution is in that.

Dr. Vanderweyde.—It may be interesting to state how Huyghens corrected the tendency of a vibrating pendulum to require more time to go through a large arc than a small oscillation. If it will vibrate in a small arc sixty times in a minute, it will vibrate only fifty-eight or fifty-nine times if the arc is greater. The pendulum will move faster in the larger arc, but not in proportion to the space through which it has to pass. Huyghens discovered the line of equal descent. A pendulum swings by the same force and in the same time that a ball would roll upon a circular arc. A ball rolling down the line of a circular arc will reach lowest part later when started at a greater distance from this point. But if two balls were placed upon the curve of equal descent, at different distances from the center, they would reach the center together. That line of equal descent Huyghens found to be a cycloid; the curve of which would be described by a nail in the rim of a wheel moving over the ground. In order to make the pendulum move in that curve Huyghens ascertained the form of the evolutic cycloid, and placed at the top of the pendulum cycloidal cheeks of that form.

The President.—The spring by which the pendulum rod is supported in the common brass clock, by its bending, attains nearly the same end in a very cheap way.

Mr. Alexander Beckers described and represented upon the blackboard a pendulum which could be made to move so slowly that a clock with a pendulum a foot in length would require but one wheel. It consisted of a fly wheel rolling upon a vertical cone, and suspended from the top.

Dr. Vanderweyde explained the principle of the pendulum used for the metronome, in which, by means of a counterpoise above the point of suspension, a pendulum a few inches in length may be made to vibrate as slowly as once in two seconds.

Alternating Battery.

Dr. Edwin McCracken exhibited his alternating battery, which consists of two batteries, so connected with a clock movement that at certain intervals they are alternately brought into action, and explained the principles upon which it is founded. He said:

This invention is for the purpose of alternating the batteries. I discovered that electricity wanted rest. It is strange, but nevertheless a fact. I took two equal zincs, in batteries charged with the black oxyd of maganese and either common salt or sal ammoniac, and one was kept in operation, and died in thirty-two minutes, while the other, which was allowed to rest one-half the time, shows to-night 3° better deflection than when I started it on the 10th of last November. In the latter case the battery was allowed to rest every five minutes by an instrument like this, which is nothing more than an ordinary Yankee clock, with a circuit maker and breaker of ivory and brass. By this the circuit is changed from one battery to the other without being broken for an instant. We change from battery No. 1 to battery No 2. so exactly that even so delicate an instrument as the galvanometer will not know when it happens, except that it swings up two or three degrees that it loses in that time. I was led to the discovery by this circumstance: I had in my house a sounder, and I had left the key open. At night I found I had no circuit. My wife, in dusting, probably hit the circuit breaker with her brush and closed it. I left the key open, and the next morning I did not intend to touch it, but by accident my overcoat struck the key and it sounded at once. This led me to the investigation how that current was produced, and I found it was from resting the battery. By changing every five minutes I found I could keep up a continuous circuit. It is like carrying a load. A man could not take 100 pounds on his shoulder and carry it far; but two men could carry it to Harlem by shifting it from one to the other. Dr. Bradley spoke of making a double connection; having four springs in his clock connecting at the same moment. I cannot see why there is any difficulty about one sure connection If it is made right and set right, one is just as good as a hundred, and the instrument cannot be burned by the electric current. I have used this battery for an electric light, which has been in operation every night for ten consecutive months using 982 pounds of zinc. Moses G. Farmer of Boston, states that at an expense of $1.42 we produce 450 candle power, burning a fourth of an inch of solid carbon. Dr. McCracken proceeded to explain how the products of a battery could be utilized. Bichromate of potash costs sixteen cents per pounds and sulphuric acid two and one-eight cents. Sulphate of chromium costs a little less than two cents per pound. The chrome alum which is produced from the products of this battery is worth sixty cents per pound. It is used as a dye in calico printing, and is next to aniline in color. The carbonate of zinc is worth thirteen cents per pound. Then the amalgam may be placed in a jar with sulphuric acid diluted by adding four parts of water to one of the acid, and the zinc will be dissolved and the quicksilver precipitated in metallic form. If the products of the battery are not thrown away the battery will support itself minus the labor. Chemistry tells us that nature wastes nothing, and we ought not to waste the products of the battery.

Dr Vanderweyde.—How do you manage at the very moment of change? Are both batteries on?

Dr. McCracken.—There is a time when both batteries are on at once, but it is very short.

Dr. Vanderweyde.—Do you find any difference from changing in a longer or shorter time than five minutes?

Dr. McCracken.—Yes, sir; there is this difference, that if a man carries a load until he is tired it takes longer to recover.

Dr. Vanderweyde.—Do different batteries require different times?

Dr. McCracken.—Every battery requires its time. Some batteries, as the Smee battery, will run as long as fifteen minutes; but you cannot make a continuous electric light with the bichromate of potash battery without changing every five minutes. There you have to change oftener because it is a battery of intensity. My battery stood fifty to one. Coupled together, it was quantity two and intensity 100. As the circuit changed the light did not waver, but always increased and came up with the new fresh battery, showing that it was rested.

Dr. Vanderweyde.—The chromic acid battery was introduced, I believe, about the year 1863. At that time I had a large carbon battery of twelve cups, in which I used nitric acid. I at once changed, and tried the chromate of potash and sulphuric acid. I was astonished that the battery ran down so quickly. It did not last more than five minutes in full power; but I found that on allowing it to rest it soon recuperated. I then made experiments comparing the recuperating power of this battery with that of the Bunsen battery. I filled six cups with nitric acid and the other six with bichromate of potash and sulphuric acid. I found that in about an hour this battery was exhausted, while the Grove battery lasted much longer. There was no battery existing that ran down so quickly as that with the bichromate of potash. The battery wanted rest; and the next question was, why it wanted rest. I found upon examination that the chrome alum was crystallizing in the pores of the carbon and choking them up, while the battery was in use, but when I let the battery rest it was dissolved again. When I took the carbon out, while it was allowed to rest, it did not do so much good, for the simple reason that it did not dissolve. But when I left the carbon in the liquid, and let the battery rest for five minutes, the battery was recuperated to its former power. I afterwards published these facts in the *Journal of Applied Chemistry.* Other batteries do not need rest so much, but they all need it; and it was a very happy thought of Dr. McCracken to make the change by clockwork, and I have no doubt it will prove valuable.

Dr. McCracken.—This is the first time that I have heard any gentleman state that the idea of a rest being required had occurred to him. But I cannot agree with the opinion as to what takes place during the rest. I have alternated it in three minutes, and the chrome alum would collect in spite of me. I will tell you my theory. We have two poles, positive and negative. We have oxygen and hydrogen gases passing, and as they meet one another they produce a wall of water which protects the zinc from the acid. The moment you break the circuit the water begins to disappear, and the battery is soon ready to act again. The water, which is between the porous cup and the chromic acid, absorbs the electricity which is generated, when this battery has been in action long enough to require rest.

Dr. Vanderweyde.—Then you mean that the layer of water would be an obstruction to the current?

Dr. McCracken.—Yes, sir.

Dr. Vanderweyde.—And that the formation of chrome alum in the pores of the carbon has nothing to do with it?

Dr. McCracken.—No; I would not say that; because it might have some effect.

Dr. Vanderweyde explained by formulæ the chemical decomposition and recomposition caused by the current of this battery, showing that it was true that water was formed along the porous cup, and possibly that this layer of water might be one of the causes of the running down of all batteries, but this does not account for the fact that the so-called chromic acid battery runs down more rapidly than any other.

Adjourned.

March 16, 1871.

Prof. S. D. Tillman in the Chair; Robert Weir, Esq., Secretary.

The Chairman read the following notes of scientific progress:

Albumen from Blood.

Albumen is now produced on a large scale, at Pesth, Hungary, and in North Germany, from the blood of animals. The serum separating when blood coagulates consists chiefly of albumen. The best quality of albumen thus obtained is transparent and soluble in water, and is used for mordanting yarns and cloth. At Pesth, blood is dried in flat iron pans, by exposure to air at a temperature of from 100 degrees to 112 degrees F. From 3,000 pounds of blood about 110 pounds of albumen are obtained, at a cost of $29; 16,200 eggs would yield the same amount of albumen at a cost of $96. Although the cost of egg albumen is three times as great as that of blood albumen, the former is preferred for dyeing purposes on account of its purity. Blood albumen of a second quality, darker in color but nearly all soluble in water, is used largely in the process of refining sugar.

A Substitute for Albumen in Analine Dyeing.

A compound of glue and tungstic acid is thrown down when tungstate of soda, hydrochloric acid and a thick solution of glue are mixed. When heated to about 100 degrees F., this compound is so soft and plastic that it may be drawn out into thin sheets, which become solid and brittle on cooling. This substance has been successfully employed instead of albumen in fixing analine colors upon cotton.

Dr. Vanderweyde.—This tungstate of soda is used to make woven fabrics incombustible. It is used extensively in some theatres to prepare the dresses of the dancers. It is the best thing for that purpose.

Litharge and Glycerin.

M. Rost has made a material suited to a variety of purposes by mixing protoxyd of lead (litharge) and glycerin so that they form a creamy liquid. In a short time the mixture becomes a hard and homogeneous mass, which readily adheres to metal and resists the action of water and steam, and is not reduced by a temperature of 527 degrees F. It is a valuable cement, and, in the fluid state, may be used in galvano-plastic copying.

Dr. Vanderweyde.—I tried that some time ago. It was recommended for stoppers of bottles; and it was so good a cement that I could never get the stoppers out any more. (Laughter.)

Compressed Leather Scraps.

An article in Dingler's *Polytechnic Journal* gives a process for utilizing leather shavings and scraps. They are first cleansed, then soaked in water containing one per cent of sulphuric acid until the material becomes soft and plastic, and afterward compressed into blocks and dried by steam. In order to soften the blocks, one pound of glycerin is added to 100 pounds of material; they are then passed through rollers, and brought to the proper thickness to be used as inner soles of boots and shoes. Leather is so cheap in this country that I do not suppose this process would be economical.

Pepsin and other Ferments Isolated by Glycerin.

The experiments of Von Wittich prove that by means of concentrated glycerin, pepsin and other so-called ferments may be completely isolated. The glycerin extracts thus obtained, with but few exceptions, remain unchanged for a long time, so that a stock of ferment may be kept in store. Another advantage gained by this process is that the tissues which have thus been exhausted of their ferment are otherwise so little changed that they can be examined under conditions hitherto impossible.

Dr. Vanderweyde.—The value of glycerin is not as well known as it ought to be. Its applications are extended more and more every day. It is used in preparing microscopic objects instead of balsam. Anatomical preparations preserved in glycerin are not dissolved as they are in alcohol, in which they become white; and as the glycerin will not evaporate, the bottle need not be sealed up. Glycerin will not freeze at any ordinary temperature; and a little glycerin is sometimes mixed with the water in gas-meters to prevent it from freezing. Glycerin prevents fermentation. Put it in glue, and it will keep; only it will not dry. (Laughter.)

Zinc Coating.

Copper and brass may be coated with zinc by immersing the article to be coated in a boiling bath of sal-ammoniac containing either sheet or powdered zinc. The zinc thus deposited is brilliant and firm.

Gilding.

In treating of the characteristics of gold, in the London *Mechanics' Magazine*, Prof. Dembinsky says, gold is so extremely ductile that a grain of it is capable of extension over an area of 56¾ square inches. Gold is employed for gilding the surface of copper, brass and silver, by the following different processes: 1. Hot gilding for the ormolu, the bright French gold for ornaments of all kinds; the metal to be gilded is first washed with a solution of nitrate of mercury or amalgamating water, which gives a silvery surface; to this surface an amalgam of gold and mercury is applied, from which the mercury is driven off by heat. The color is then heightened by burning it on Calder's wax, formed of wax, verdigris and blue vitriol; it is then polished and brightened by a boiling solution of common salt and cream of tartar. Some adepts heat the article on a hot iron plate provided with small apertures, and when heated apply some solution of iodine and yellow ochre with a brush. 2. German gilding of silver is performed by a solution of gold in nitric acid, to which sal ammoniac and alembroth (a triple salt formed by salt and ammonia and corrosive sublimate) have been added. This solution of gold evaporates to the consistency of oil, and is then applied to the silver or nickel, both of which it blackens, but they appear gilded on being heated. 3. Gilding is also performed by rubbing the metal with the ashes of linen rags which have been impregnated with a solution of gold. 4. Wet gilding by merely dipping the work in a solution of gold. 5. Gilding by the well known process of electro-plating.

Dr. Vanderweyde.—The solution of the terchloride of gold in ether is a convenient means of gilding the inside of a bottle.

Distinctness of Distant Sounds.

Mr. C. R. Moore, of Washington, D. C., during the first four and last three months of 1870, made a series of observations on sound, which gave unexpected results. The sources of sound were the guns of Fortress Monroe (distant about forty miles from Prospect Hill, the point of observation), and Sue's whistle at Cherry Stone (thirteen miles distant), and at Hungar's wharf (eight miles distant), all in a southwesterly direction from the point of observation. During the months when the intervening woods were in full foliage, the sounds were almost or entirely lost. A table, giving for forty-four observations the intensity of sound, and the force and direction of the wind, shows that sounds of maximum intensity were heard when the wind was blowing from the north, as well as from the north-east and north-west. The cause of the progress of sound against the wind is unexplained; but it is probable that had barometrical and hygrometrical observations been also made, some clue would have been found to the cause of this curious result.

Dr. Vanderweyde.—I have long been looking for the results of experiments upon the velocity of sound as affected by wind.

Mr. C. B. Boyle.—It has been found, in light house experiments, that when a cloud hangs low over the water, sound will travel much further than under ordinary circumstances.

The President.—It may have been that clouds, in these experiments in Washington, had a good deal to do with the results obtained.

ORIGIN OF GRAPHITE.

Prof. Wagner ascribes the deposits of graphite, plumbago or black-lead, which are found in a great variety of rocks of different geological periods, to the decomposition of cyanogen, which is a combination of carbon and nitrogen, or of the cyanides. In several chemical processes, used in the arts, graphite is formed artificially; and it is not impossible that this expensive mineral, the best specimens of which are now brought from the island of Ceylon, may be produced artificially in such quantities as to be made available in several branches of manufactures where this mineral is indispensable. Chemists, however, have not yet accepted Prof. Wagner's explanation, or any other as to the natural production of graphite.

Dr. Vanderweyde.—I think that idea must be taken from a preconceived notion; for carbon is not found to any great extent except in the animal or vegetable kingdoms. The amount of carbonic acid in the air is so enormous, that if all the mineral coal in the whole world were burned up, the proportion of carbonic acid in the atmosphere would only be increased to a very small extent. Philosophers generally ascribe all forms of carbon to vegetable and animal life, which in geologic ages have been transformed into coal and other substances containing carbon. Coal is derived from vegetation. Petroleum is a hydrocarbon derived from the remains of animals, chiefly molluscs, and perhaps to the greatest extent microscopic ones. It has been suggested that the diamond, which is pure carbon, is of vegetable origin; and it has been asserted that remnants of vegetables have been found inside of diamonds. Grey cast iron contains graphite diffused through the mass; so that it is rich in carbon.

KAOLIN.

Dr. C. Bischof describes, in Dingler's *Polytechnic Journal*, a series of experiments made with porcelain clay from ten different localities, his object being to determine the value of these various kinds of kaolin by means of a pyrometrical method. The standard sample was the levigated kaolin from Zettlitz, Bohemia. This consists, in 100 parts, of alumina, 38.54; chemically combined silica, 40.53; silica as sand, 5.15; magnesia, 0.38; lime, 0.08; peroxyd of iron, 0.90; potassa, 0.66 (loss by ignition, 13.00). This sample, in powder, was compressed into the shape of small cylinders, and then heated to the temperature of the melting point of platinum by itself. After carefully examining the effect of this ignition, a flux of from one to two-tenths of the weight of the kaolin was added, and the cylinders were again subjected to the same high temperature. In the same manner, the several samples from other localities were tested.

UTILIZATION OF SEWAGE.

A novel method of sewage purification and utilization has been devised in England by Dr. Apsley Price and David Forbes, F. R. S. It is founded on the fact that certain mineral phosphates, easily obtainable, especially those containing alumina, when in a hydrated or freshly precipitated state, eagerly combine with the organic matter contained in sewage, it being sufficient merely to agitate them in the most fetid sewage to deprive it of all its odor and color, even if tinctorial substances of great intensity be present in the solution at the same time; while the phosphate of magnesia combines with the ammonia contained in the sewage, and precipitates it also in the state of the double phosphate of ammonia and magnesia. The precipitate subsides rapidly, and the remaining water is quite transparent and colorless; it is also nearly tasteless, and can with safety be drawn off and discharged at once into the nearest natural stream. The process is an extremely simple one, and requires nothing beyond an ordinary reservoir for holding the sewage during the operation. The phosphates are preferably added to the sewage in solution, in sulphuric or hydrochloric acid, and their precipitation in the hydrated form, along with the organic matter in the sewage, and more or less ammonia (dependent on the strength of the sewage, and length of time it has been allowed to stand), is instantaneously effected by the addition of a small quantity of milk of lime, just sufficient to neutralize the acid which holds them in solution. The use of the natural phoshate of alumina is especially recommended.

Dr. Vanderweyde.—This is a very important item. Alumina is the agent used in precipitating many things which are dissolved in water—coloring matter, for instance. That is the way madder and other lakes are made. A solution of alum precipitates the coloring matter. At New Orleans, alum is used to purify the water from the Mississippi river, in the manufacture of ice. It is not surprising that the phosphate of alumina will do the same thing as common alum, which is a sulphate of potash and alumina, and precipitate organic matters in suspension and solution. The precipitate must be valuable, because good soils must contain alumina and phosphates. The most fertile soils contain the decomposed remains of feldspar, which is chiefly alumina and silica, and is similar to common alum. This is a very happy idea; by this means we get rid of the bulk of the sewage, and to secure the most valuable ingredients, while adding to them a substance which will increase their value for fertilization.

Drying Retards Decomposition.

Prof. A. W. Williamson, of London, has recently delivered a series of lectures on fermentation, from one of which the following is condensed. All processes of fermentation are accompanied by moisture. The little organisms which cause fermentation are soft and wet; moisture constitutes a great part of their substance, and in a dry medium they cannot live. Applications, therefore, of a mere drying process are among the most important and interesting of this class of agencies. Germs of putrefaction or decomposition may be present in fruit, but if you merely take away the greater part of the moisture, you render the substance incapable of decomposing. Among the agents which serve for that purpose, there are some which abstract the water, not in a state of vapor, but in the liquid state. If you put a piece of fresh meat in contact with salt, or rub it over with salt, the salt gradually absorbs the water. The action is truly a drying action upon the meat, and it is effectual. In like manner it is known to many persons that sugar is used just as salt. It is said that ordinary jam—fruit and sugar which have been boiled together for some time—keeps better if the pots into which it is poured are tied up while hot. If the paper can act as a strainer, in the same way as cotton-wool, it must be as people suppose. If one pot of jam be allowed to cool before it is tied down, little germs will fall upon it from the air, and they will retain their vitality, because they fall upon a cool substance; they will be shut in by the paper, and will soon fall to work decomposing the fruit. If another pot, perfectly similar, be filled with a boiling-hot mixture, and immediately covered over, though, of course, some of the outside air must be shut in, any germs which are floating in it will be scalded, and in all probability destroyed, so that no decomposition can take place.

Dr. Vanderweyde.—The same theory applies to glycerin; for that preserves by extracting water. The preserver of water is a necessary condition of fermentation. But we cannot destroy the germs by the mere extraction of water. We can only arrest their germination; and when water is again applied, the germs will develop. Some animalcules, especially the rotifera, have such a strong tendency to be revived, that they have lived after having been dried fourteen times and kept fourteen years. Some germs are not killed even by hydrocyanic acid. It is necessary to shut off the air from anything we wish to preserve, for the air is full of germs, ready to develop the moment they have an opportunity. But there is no such thing as spontaneous generation.

SEA CURRENTS.

Dr. Carpenter read a paper at a recent meeting of the Royal Geographical Society of London, in which he gave an account of observations of the Gibraltar currents, made during a recent cruise of the British ship Porcupine. The chief point enunciated, was that there was special local circulations in the Mediterranean and other inland seas. The immese evaporation over the surface of the Mediterranean produced the in-current of salt water, the evaporation increasing the density of the Mediterranean water, which flowed out through Gibraltar at a lower level near the bottom. The fresh water running into that sea floated on the top, but did not equal the loss by evaporation. There was thus an excess of salt and consequently an excess of weight, per height of column, of the inland waters over the oceanic waters without; this increased gravity produced pressure, and the pressure caused the outflow. The experimental researches were stated in detail which confirmed this theory. The existence of an undercurrent in the Strait of Gibraltar is said to have been first proved by a sea captain, by means of a rope attached at one end to a small boat, and at the other to a basket of stones sunk at a considerable depth. The basket of stones was acted upon by a strong outflowing with such force that the boat was towed out against the inflowing surface current. The converse took place in the Baltic and Black seas. According to Dr. Carpenter's theory, similar in result as to general oceanic circulation was the effect of cold at the polar, and heat at the equatorial regions. The action of cold on salt water was different from that on fresh water. The salt water became denser and heavier with the cold up to the point of its solidification, which was at a much lower temperature than 32° Fahr. Consequently there was a contraction and a downward motion of the sea water at the poles. On the other hand, there was an expansion and an uprise of the sea water at the equator. These two actions produced an outflow of a cold stratum in the lower depths from the polar regions and an inflow of the warm surface waters from the equatorial hot regions. This theory was illustrated by a very pretty experiment in a glass trough with a heated surface at one end and a wedge of ice at the other. Blue and red pigments were let in to show the motions of the liquid. The red cloud traveled in one direction and the blue cloud in the other. This occular demonstration was very convincing.

Dr. Vanderweyde.—The current on the surface at the Straits of Gibraltar has long attracted attention, because it was difficult to understand why there should be such a current, when there are the Nile and other rivers flowing into the Mediterranean sea. They have taken great pains to find a lower current running into the ocean to explain that; and now it seems they have found it. But when we take into account the evaporation; that explains it all. When we look at the map we see how large the Mediterranean sea is, in comparison with the surface of the land drained by it, and how few rivers flow into it. We see that the Caspian sea has a much larger river running into it, has a smaller surface and a colder climate; and yet evaporation there is sufficient to keep its surface eighty feet below the level of the ocean. The Mediterranean has so small an amount of land to drain, and has so large a surface for evaporation, that the water must flow in, as it does at the Straits of Gibraltar, and also from the Black sea, which receives more water than it can evaporate. That is the whole explanation. The salt water in the ocean comes from the rivers, and the ocean gets salter and salter all the time. There is no river which carries pure water into the ocean. They always have substances in solution, but the water evaporating from the ocean is pure rain water. The Amazon carries into the ocean forty millions of tons of solid matter every year. All the rivers are hard water, to a greater or less extent; and even Croton water contains more salt than rain water. The ocean for millions of years has been receiving all the impurities of the whole earth, and giving back pure water; and it is no wonder that the water of the ocean is salt. The salt flows into it and cannot get out. Our Salt lake, which has no outlet, is a perfectly saturated solution of salt, containing two or three times as much salt as ocean water; and the Caspian sea is nearly saturated.

The President.—The Dead sea is a thousand feet below the level of the Mediterranean sea; but the evaporation is so great that the level is kept down.

Dr. Vanderweyde stated that, in geologic epochs, Spain was connected with Africa, and England with France, and at that time the desert of Sahara was an ocean.

Mr. Robert Weir.—Is it a fact that the surface of the desert of Sahara is lower than the level of the surrounding ocean?

Dr. Vanderweyde.—It has been so asserted; but it has not been proved, and I do not believe it. I know that, in a trough of water, the heavier water may go one way and the lighter the other way. But, in the Mediterranean, I know positively that the evaporation must be considerably more than the supply, and therefore water must flow in.

The President.—How do you account for the outflowing under current?

Dr. Vanderweyde.—It must be insignificant. It is a new discovery. The top current is very strong all the time.

Mr. Boyle.—I think it is a mistake about its being a new discovery. There is a statement that a Dutch brigantine, loaded with salt, in the early Napoleonic wars, sunk there; and after the salt was dissolved, she rose, and was found thirty miles further out, upon the Barbary coast. It was then concluded that she must have been carried out by an under current.

Hon. William J. McAlpine, formerly State Engineer.—I had occasion, some years ago, to ascertain the amount of evaporation from the surface of the water in this State, and it amounted to about five feet per annum. I have had frequent occasion, in the course of my profession as a civil engineer, to make similar investigations in other places; and I have found the evaporation, further south, to amount to seven or eight feet per annum. The surface which drains into the Mediterranean sea has a superficial area three or four times as great as that of the sea itself; and no current into the Mediterranean sea can take place, according to my idea of it, from mere evaporation. There must be some other cause. That this outward current exists, is doubtless true. There is a circulation of water going on, not, I think, due to the excessive evaporation from that particular sea, but due to other causes. Call the evaporation six feet, or seven, if you please. Then calculate the area which sheds its water there, with a rain-fall of thirty to forty inches, and you will find the drainage to amount to perhaps twice the amount of the evaporation.

The President.—It is a singular circumstance with regard to the Mediterranean, that, on the south, there is no river but the Nile discharging into it; and that, from the south, there is a constant hot wind from the desert of Sahara, blowing over the sea, absorbing an immense quantity of moisture, and producing a sensible effect up in Central Europe. Probably the evaporation from the Mediterranean sea is greater than anywhere else in the world.

Mr. McAlpine.—Along Lake Erie, the water-shed on the south is only fifteen miles in width, while on the north side it is one hundred miles or more. At Lake Michigan it is the same. It is a curious fact that, in many places, we find the quantity of water flowing north very small, and that flowing south very large. There is an immense area of country north of the Mediterranean, which empties directly or indirectly into it, and no evaporation can account for it.

Dr. Vanderweyde.—I think it fully accounts for it. The water in the rivers flowing into the Mediterranean is very little. The watershed of the whole Mediterranean is only about double its surface.

Mr. McAlpine.—It is quintuple, I should judge.

Dr. Vanderweyde.—I invite the gentleman to look at the map. They are all insignificant rivers. The only large river is the Nile, and that only for a short season of the year. There is not a single river so large as the Volga, and that is wholly absorbed by the Caspian sea.

Mr. McAlpine.—The Danube.

Dr. Vanderweyde.—That flows into the Black sea; part of it is evaporated, and the remainder flows through the Bosphorus and the straits of Dardanelles into the Mediterranean. But it amounts to less than the evaporation, helped a little by Etna and Vesuvius, and there must be a current inward from the Atlantic ocean.

The President.—How do you account for the outflowing current?

Dr. Vanderweyde.—It must be less than the inflowing current. The evaporation is enormous, and it must be balanced with the rainfall, or there must be a supply of water from some other source. People used to think there was a subterranean outlet from the Caspian to the Black sea, to account for the water of the Volga not raising the level; but we find that the Black sea is eighty feet higher, so that if there were such a passage the water would flow from the Black sea into the Caspian. The result would be that the Caspian sea would have double the surface or more, and then the evaporation from it would be doubled, and then the evaporation would again balance the amount of water flowing in.

Dr. L. Bradley.—Lieut. Maury, in his Physical Geography of the Seas, states that the evaporation from the ocean has been estimated at nine feet per annum. I have had occasion to investigate the subject, and I have satisfied myself that that is not far from correct. The evaporation from the whole surface of the ocean at that rate would amount to over 2,000,000,000 tons of water every minute of time.

Mr. McAlpine.—The questions of evaporation and water drainage resolve themselves into plain common sense questions. All the fresh water we find upon the surface of the earth comes from the clouds, and is clearly evaporated from the sea. We have therefore the measure to know how much has been evaporated. All that has gone up must come down. The annual rainfall we may consider here about three feet, but in the East Indies it will amount to ten feet. In any particular district of country the evaporation and the rainfall must balance each other. It is a remarkable circumstance that at Mackinaw Straits the government engineers report that the flow of water is always toward Lake Huron. In other words, the evaporation from the surface of Lake Michigan is insufficient to carry off the water that comes in.

Dr. Vanderweyde.—Do you conclude that the Mediterranean receives more water than it evaporates?

Mr. McAlpine.—I think it does. Warm air absorbs a large amount of moisture; but it is like a sponge, and as it passes over the land and diminishes its temperature, the moisture is precipitated. It is like squeezing a sponge, and so more and more is precipitated until it reaches the top of the mountains, when it is entirely precipitated. It flows back through the water courses toward the ocean, and it is again evaporated.

Dr. Vanderweyde.—The evaporation and the rainfall balance each other, of course; but we must take the whole surface of the earth. Compare Kansas and Alaska. In Alaska there are only thirty days in the year when no rain falls, and it is so cold a climate that there is little evaporation. Therefore the rainfall there must be larger than the evaporation, while in Kansas and Colorado we know that the rainfall must be much less than the evaporation.

Mr. Boyle.—In the case of the brigantine, she must have been in the upper and under current nearly an equal length of time, so that the under current must have been greater than the upper current.

The President.—It is important to have the means of ascertaining directly the relative amount of moisture in the air at any given degree of temperature. It would solve a great many questions still remaining in doubt. By the hygrometers now in use, we determine the actual amount of moisture in the air, or how much it lacks of reaching the point of saturation, that is, the dew-point, and to ascertain the amount which we should have for a given temperature, we must make a calculation. What I propose is an instrument to show, without calculation or tables, the amount of moisture due to the temperature. For instance, if the temperature is seventy degrees, the instrument will show how much moisture must be added to or withheld from the air to produce the proper moisture for that temperature.

Mr. McAlpine.—I have now under consideration the ventilation of the capitol at Albany, of which I am engineer. The question of ventilation includes something more than heating and cooling the atmosphere in the two chambers. We must take into account its hygroscopic condition. In laying the foundations of the capitol, which are now done, I have prepared for that precise thing. I have chambers, one to warm or cool the air, another to add moisture to the air or to deprive it of moisture, and another to give pressure or attenuation to the air. I propose that the attendant engineer shall know by the hygrometer the amount of moisture in the air and shall regulate it. And so with regard to the pressure, which it has been suggested will be sometimes very convenient. If a tedious man has the floor all the speaker will have to do will be signal to the engineer to attenuate the air, and instead of speaking an hour he will subside in ten minutes; or if a measure is to be carried, the engineer puts on the pressure, the debate becomes eloquent, those who listen are interested and convinced, and the work is done. (Laughter.)

A member inquired whether there was a constant level of water beneath the surface of the earth.

Mr. McAlpine.—As I stated a little while ago, all fresh water comes from the clouds. If you have a spring of fresh water, you may be sure it comes from some point of ground higher than that at which it issues. On Long Island there is a peculiar formation of country. The south portion of the island is entirely sand, gravel and porous soil. About twenty years ago I took lines of levels of every stream and well running from the ocean northward, and discovered a remarkable fact, viz., that the water slope descended at the rate of about six feet to the mile, sometimes more and sometimes less; so that it is possible to determine within about a foot how deep you will have to sink a well to reach fresh water, by reaching this sheet of water which is flowing down to the ocean. Within fifty miles of Fulton ferry we can find more water than is necessary to supply the city of London. By actual measurements I found that there was a supply of 75,000,000 gallons daily within fifty miles of Fulton ferry. We must anticipate the water as it flows down toward the ocean. The fresh water flows over the salt water, which you would find if you were to dig deeper.

Improvement in the Microscope.

Dr. P. H. Vanderweyde said: I desire to say a few words in regard to some microscopic investigations which are of some importance. Many questions of the causes of disease are at once settled by the microscope; and so are many questions in mineralogy, botany and all the natural sciences. Thus the improvement of the instrument has lately been much stimulated. Not only have the mechanical portions been much improved, but the optical quality of the lenses. The labor spent on some of the lenses of high power is enormous. It takes months to finish them, and they cost from fifty to $200. Those made in the United States appear to be at least equal to foreign lenses. Indeed, it appears that you can be much more sure of uniformity of results by taking an objective of American manufacture, and it appears to be due to the greater fidelity of the American workman.

The test of lenses was once the dust upon the wings of butterflies. We have now got far beyond that. It has been discovered that a great many mineral deposits are remnants of the shells of animalcules. Chalk beds, and tripoli, though so fine as not only to look but to taste like flour, the microscope reveals to consist of shells, millions upon millions to every cubic inch. The amount of these remains is so enormous, that if they were to be swept from the earth, the change upon the earth's surface would be greater than if all the remains of larger animals were to be entirely destroyed and removed. We have in South America and California ridges 200 or 300 feet high, and 100 miles long, which would be entirely swept away.

By improving the lenses of the microscope, it has become possible to classify these shells, and a new trade has sprung up from their preparation and arrangement, for the study of the animalcules, which were undoubtedly the first trace of animal life, and of life in general, existing upon our globe. These are prepared for the microscope on slides on which there are fifty, 100, and even 400 species of these shells, arranged in rows, the whole 400 occupying space not larger than the head of a pin, accompanied by a printed catalogue and description. How they are arranged is a mystery, and that they are arranged at all is a proof of the utmost dexterity. Find a hair which is split, cut off the end square, and then press the end upon glass, and the split will open. When it is raised from the glass it will close again. So it may be made to grasp a little shell, and in that way you may transport it. So it is necessary to "split hairs" in the study of these shells. (Laughter.)

Examining these little shells with the microscope, we see fine parallel lines upon them. By changing the light, another set of lines is seen crossing the former at an angle of 60°; and by again changing the light, a third set of lines is seen. After some time, it was discovered that these three sets of lines were not straight, but serpentine, and then that they were the intersections of hexagons. But still later it was ascertained that these were not hexagons, but little spherical balls standing at regular distances. Now, it appears that all the lines of diatoms are caused by these little balls, which are all silicious. But it is necessary that the light should be changed in its direction, and modified in various ways, in order to show all these details.

Usually the object is covered with a piece of glass as thin as letter-paper. Now we must have oblique illumination. Sometimes the mirror was arranged to shift sideways, and sometimes a prism was placed to illuminate the object by total reflection. I have adopted a different plan. I placed a piece of very thin looking-glass immediately under the object, and then, by illumination through an ordinary bull's-eye lens, such as is used in viewing opaque objects, I let the light fall upon the mirror just below the object and a little one side, the side towards the lens, and be reflected so as to strike the object just at the angle I desired. With this arrangement I found that I could secure a very exact adjustment of the direction of the light.

Now as to the results. There has been a discussion about the *Arachnide discus*, which is a round disc resembling a spider's web in the lines visible upon it. Throwing the light upon it as I have described, I found that those lines are produced by little round balls, every one having its own shadow, and every one showing the little point which is seen in a transparent ball from the converging of the light to a focus, just opposite to the light, showing that each of these balls is a globe of flint or silex standing on the top of the shell. The minuteness of these little balls may be imagined, when I say that each of these discs—the whole being invisible to the naked eye—contains upon its surface at least six hundred of these balls of silex.

I will close with a curious discovery. Why are these objects covered with those flint balls? It has been discovered that silex, precipitated from fluo-silicic acid, when examined through the microscope, is seen to form the same little round balls visible on the diatoms, showing that they are produced, not by animal action, but by the crystallization of the silex itself.

Adjourned.

March 23, 1871.

Prof. S. D. TILLMAN in the chair; ROBERT WEIR, Esq., Secretary.

The Chairman presented the following scientific items:

MOLDS AND MILDEWS.

The Gardener's Magazine says these minute vegetable forms are often productive of serious detriment to a variety of industrial operations. Take, for example, the old fashioned method of bleaching, by exposing fabrics for several days upon the bleaching ground, so that the dew, by a slow process of oxydation, may remove any colored organic particles remaining in the stuff. This moisture encourages the development of sporules deposited in the air, which produce those discolored patches known by the French country-folk as *hendrissures*, and which it is almost impossible to remove without injury to the texture of the material. So in the manufacture of gelatine, of vermicilli, macaroni, and all kinds of Italian pastes, the presence of these minute organisms will often produce a sort of putrid fermentation, destroying the entire product. The mold which forms in empty casks is another example, and the disagreeable flavor sometimes found in wines, which we then describe as "corked," is probably due to the formation of vegetation in the pores of the cork. There is reason to believe that all the changes in fermented liquors, which we are accustomed to regard as spontaneous, are due to the development of rudimentary vegetable forms.

OZONE GENERATED BY THE ESSENCES OF FLOWERS.

Prof. Mantegazza lately read a paper before the institute of Lombardy, on his experimental researches on the action of the essences of flowers in producing atmospheric ozone, and the following is a summary of his conclusions: 1. The essences of mint, turpentine, cloves, lavendar, bergamot, anise, juniper, lemon, fennel, nutmegs, cajeput, thyme, cherry, laurel, in contact with atmospheric oxygen in light, develope a very large quantity of ozone, equal, if not superior in amount to that produced by phosphorus, by electricity, and by the decomposition of permanganate of potash. 2. The oxydation of these essences is one of the most convenient means of producing ozone, since even when in very minute quantity they can ozonize a large quantity of oxygen, while their action is very persistent. 3. In the greater number of cases the essences, in order to develop ozone, require the direct rays of the sun; in a small number of cases they effect the change with diffused light; in a few or none in darkness. 4. In some cases, however, the action just commenced in solar light was found to persist to some extent when the essence was placed in darkness. 5. In some cases a vessel perfumed with an essence, and afterwards thoroughly washed with alcohol, and perfectly dried, could still develop a proportionate quantity of ozone, provided that it retained a slight odor of the essence. 6. Essences that developed the largest quantity of ozone were those of cherry, laurel, palma-rose, cloves, lavendar, mint, juniper, lemons, fennel, and bergamot; those that gave it in less quantity were anise, nutmeg, cajeput and thyme. 7. Camphor, as an ozonogenic agent, is inferior to all the above-named essences. 8. Eau de cologne, honey water, and other perfumes of aromatic tinctures, develop a proportionate quantity of ozone when they are exposed to the direct rays of the sun. 9. The flowers of the narcissus, hyacinth, mignonette, heliotrope, lily of the valley, &c., develop ozone in closed vessels. Flowers destitute of perfume do not develop it, and those which have but slight perfume develop it only in small quantities. In view of these facts, the professor recommends the use of flowers in marshy districts, and in places infected with animal emanations, as the powerful oxydizing influence of ozone may destroy them. The inhabitants of such regions should surround their dwellings with beds of the most odorous flowers.

Wax Milk.

This name was given by the late Dr. F. F. Rung, of Prussia, discoverer of the aniline colors, to a valuable water-proof compound which is used for imparting a polish to wooden articles and for coating packing-papers. It is made by dissolving twelve parts of carbonate of potash in ten times their weight of water; this is heated to the boiling point, and four parts of yellow wax are then gradually stirred into it. When the ensuing effervescence has ceased, 120 parts of water are added, and the liquid is again heated until it assumes the appearance and consistency of milk. The composition may be further improved, for some purposes, by first melting common resin with the wax; the compound thus made is more tenacious and flexible than any with either common resin or wax alone. Wood coated with this mixture will bear washing with cold water, and on being rubbed will assume a fine lustre. The mixture may also be used for protecting statues and architectural decorations.

EVAPORATION.

Dr. P. H. Vanderweyde.—I desire to say a few words in continuation of the subject we discussed at the last meeting, upon the rainfall and evaporation of the Mediterranean sea. I have made a careful measure, from correct maps, of the surfaae of the Mediterranean, the Caspian sea, the Black sea, and the surfaces drained by those seas. The assertion was made here that what goes up must come down. That is true as regards the whole surface of the earth, but by no means true for a particular country. In Alaska, where the climate is cold, and it rains 300 days in the year, the rainfall must be much more than the evaporation. Water comes down in one place which must have gone up in another. It was stated that the measurement of the Mississippi verified the assertion made, for the amount of water flowing down the river was equal to the amount of rainfall on the land drained by the river. That is a fallacy altogether. Not half the water comes down the river that falls. First, there is the evaporation from the soil itself; second, the vegetation and forests take up an enormous amount of water; and, third, there are subterranean channels through which the water flows, as proved by artesian wells, reaching the ocean without passing down the channel of the river.

The President.—Do not trees exhale more than they inhale?

Dr. Vanderweyde.—That cannot be the case, because the wood is formed from oxygen and hydrogen from water, combined with carbon, from the carbonic acid gas in the atmosphere. It is proved also by the floods which occur where forests are removed. There never have been such floods at the city of Baltimore, as have occurred since the forests have been destroyed, which had retained the moisture.

I have prepared a table of the surface of the Caspian and other seas, and of the land drained by them:

SEAS.	Square miles inflow.	Square miles drainage.	Ratio.
Caspian	180, 000	1, 000, 000	1:5¼
Aral	34, 000	170, 000	1:5
Black	400, 000	10, 000, 000	1:25
Mediterranean	1, 500, 000	2, 000, 000	1:1⅓

I will mention here, that I found a mistake in Colton's atlas; that in all cases he gives the surface only one-tenth what it should be.

The Caspian sea, and sea of Aral, are two inland seas, one eighty feet below the level of the ocean, and the other as far above that level, which show that in that climate the evaporating surface is about one-fifth that of the surface drained. Neither of these seas have any outlet. If the evaporating surface was too great, therefore, the water would dry away; or if the evaporating surface was too small, the sea would fill up, until the extent of its surface should be exactly that required to balance the rainfall. But when we come to the Black sea, in which I have included the sea of Azof, which is connected with it, its surface is far less than is required to evaporate the rainfall flowing into it, and it therefore has an outlet into the Mediterranean.

But when we come to the Mediterranean, we find its surface but little smaller than that of the land drained by it. Its evaporation, therefore, must be considerably greater than the amount of water it receives from the rivers flowing into it, and the deficiency must be supplied by the current from the Atlantic, through the Straits of Gibraltar. From the hot winds blowing over it from Africa, it is evident that the evaporation there must be greater than in the Caspian sea. The surface of the Dead sea is about 400 sq. miles, but we must add that of the sea of Tiberius, making the two 500 sq. miles; we find that in that climate they evaporate the rainfall from a surface of 4,000 miles, making the ratio 1:8. The inflowing current through the Straits of Gibraltar explains the reason why the water of the Mediterranean is salter than that of the ocean; so much so, that salt-works outside of the straits have been abandoned, while they still manufacture salt with success from the water of the Mediterranean.

The following paper was read by its author:

THE ATWOOD STEEL PROCESS.

By B. F. Tefft, LL.D.

Some three years ago, Mr. James E. Atwood, of Bucksport, in the State of Maine, a practical machinist, and a gentleman of great inventive genius, discovered a method of making every grade of steel out of the lowest grades of iron.

After filing his caveat in the secret archives of the patent office at Washington, he proceeded to work out his discovery, and reduce it to practice, in different parts of the United States. Being without wealth, and having the acquaintance of no very influential friends, he worked along in obscurity, and against the settled prejudices of nearly all persons hitherto engaged in steel manufacture.

Struggling along in this way for about one year from the time of his great discovery, during which period he was at work perfecting and reducing it to his control, he at length engaged the services, as he informs us, of his nephew, Mr. J. Edwin Sherman, to work his process, and to bring it to the notice of steel and iron manufacturers.

Up to this time, Mr. Atwood had held his discovery as a secret; and as a secret it was given to Mr. Sherman, who began at once to make use of it in the same manner. Demonstrations of the process were made by Mr. Sherman at Pittsburgh and at Washirgton. Large quantities of this new and improved steel were made and tested by government officers and experts, at the Washington navy-yard, in the presence of many distinguished persons, all of whom were astonished at what they had seen produced. So great, indeed, was the success of these demonstrations, that Mr. Sherman had no difficulty in finding capital for the erection of works at Bucksport, in Maine, his native place; and Mr. Atwood, with equal ease, obtained the means of erecting similar works at Minerva, in Ohio, both of which have since continued to make steel in large quantities for the market by this new and ingenious process.

Among the distinguished individuals who witnessed the tests at Pittsburgh and Washington, the honorable W. F. Ward, scientific *attache* of the British legation at the seat of government, took a most lively interest in them. He reported what he had seen to Sir Edward Thornton, the English minister at Washington, who, in turn, reported the same to the British government; and immediately thereupon, as soon as the dispatches could cross the ocean, Mr. Sherman received an invitation from Lord Clarendon to visit England with this great discovery.

In the meantime, and just prior to the receipt of this British invitation, the report on the new process was made out by the experts and officers of our government, and a letter, highly commendatory of it, was added to the report, from the hand of Secretary McCulloch, then just leaving the treasury department. The report of the experts is exceedingly just to the merits of the process, showing the superiority of the steel over every steel known in modern times, and reminding us that possibly "the lost art" of the Damascus manufacture had been recovered; and the Secretary's letter records the commercial value of the new method, by showing that from 200 to 300 percentum could be saved in the expense of making it over the cost by any other process.

Armed with these certificates to the value of the new method, Mr. Sherman continued for several months to exhibit it in various parts of the United States, and then, by the advice of the writer of this paper, accepted the invitation of the British government, and went to England; and, to make my narrative intelligible, as well as to show that, in what I testify, I am relating what I know of its success in England, I must add that I went to Europe with Mr. Sherman, to aid in presenting it to the British government and public.

On presenting ourselves to Lord Clarendon, we were received with the greatest cordiality by that nobleman. He seemed evidently to remember, without a word of explanation from us, the object and occasion of our visit, referred to his letter of invitation, and spoke of the deep interest England had in every *real* improvement in the methods of manufacturing iron and steel. From the information given him by Sir Edward Thornton, he was convinced, he said, that we had possession of a most remarkable discovery; he stated that Mr. Ward and the Washington legation seemed to look upon it as the greatest discovery of modern times; and he wished that we would put ourselves under his charge until we could make full proof of these statements and beliefs of his informants.

We, of course, consented to this suggestion; for it was for that purpose that we had gone to England; and, after a lengthy conversation, lasting for full two hours, we were taken by Lord Clarendon to Lord Childers, first lord of the admiralty, and by the latter at once introduced to Mr. Read, at that time chief constructor of the navy, who was instructed to furnish us with everything we might desire for our demonstrations.

No paper of this kind could give anything more than a very compendious statement of the results of our work while I remained in

England. No details can be given. I remained there for over nine months, and witnessed repeated trials of the process in the best steel works in England, and by the side of the operations of steel manufacture under the old methods. I saw the sample thus produced in the presence of government experts tested by other government experts. Everything was conducted with scientific accuracy and with perfect fairness. Though the experts and officers employed had the reputation of their own manufacturers to defend, and were not likely to overstate our success, I am compelled by truth to say that their several reports to the superintendent in charge, and his general report to the British government, were at once both fair and just. Facts were stated and left to make their own impression; and the figures of that general report show, what is also stated in the concluding words themselves, that the steel we produced by the Atwood process surpassed the English steels of the same grades by an average of about one hundred per cent in ductility and tensile strength, though in part made of materials so poor that no manufacturer in England pretended to use them in making steel, and in part of other materials so worthless as to have no commercial value. So says the report; and having thus obtained the approval of both governments, both as to the higher *quality* and lower *cost* of this Atwood steel, and in public documents now in our possession, I considered my work in England done, and so returned to the United States, leaving Mr. Sherman still prosecuting the commercial part of the enterprise on the other side.

While we were thus at work in England, Mr. Atwood, the discoverer, was at work in the United States. In his works at Minerva, as well as in several other factories in this country, he showed the inestimable value of his discovery in the manufacture of ingots of steel, to be hammered or rolled out into bars and plates in the ordinary way; and his success consisted in using materials so poor that other manufacturers could not use them, and yet producing a better class of products than had before been made out of the rarest and most costly irons.

Having thus confirmed himself in this portion of his enterprise, and made many converts to his process, his inventive mind was next turned to the subject of casting steel in form. Like all the old manufacturers, he first employed baked sand-moulds. These moulds, as is well known, are made in iron boxes, in damp sand, and then placed in hot ovens, and kept there in strong heat till they are baked thoroughly dry. The necessity for this tedious and expensive drying process arises from the phosphorous contained in nearly all the ores of iron; for it has always been known that if the smallest percentage of this inflammable substance comes in contact with the least quantity of water, or even dampness, the whole mass of molten metal will explode, throwing the iron box into the air, and endangering the lives of the operatives, and oftentimes the buildings in which they work.

But the cost of these iron boxes, and the great delay and expense of baking to absolute dryness the sand-moulds within them, and more especially the risk of not getting them dry enough to prevent these dangerous and oft-occurring explosions, had always rendered this process of casting steel in form nearly worthless. It was resorted to only when they could not get along without it in some special case. But Mr. Atwood, with a knowledge of all these difficulties, went to work to evade or overcome them. In his former experiments, but without knowing it, he had already overcome them; for, by having discovered a process of entirely eliminating phosphorus, as well as sulphur and other impurities of iron, he had reached the possibility of casting steel in green or wet sand without danger of explosion; and he had only to make the trial to demonstrate his success. He at once made the trial, and he found that, when thus purified, the metal, after being converted into steel, would lie in damp, and even very wet sand, as quietly as melted led. His success, indeed, in this second branch of his great discovery was sudden and complete.

Fearing that so important and wonderful a discovery might not be kept a secret, but be divulged by workmen whom it would be essential to employ, Mr. Atwood, who had filed his *caveat*, soon after his discovery, in the secret archives of the Patent Office at Washington, made application for letters patent during the last summer, and letters were consequently granted to him on the 13th of September last.

No sooner had his letters patent been issued to him than capitalists came forward and supplied him with the means of putting his discovery into the market, and getting it into operation throughout the United States; and this is the work in which he is now engaged.

Besides the making of all the grades of steel from the poorest of irons, as well as directly from the various ores, in the form of ignots, to be rolled and hammered into plates, bars and rods, he is now prepared to cast in steel everything hitherto made of iron or steel, steel railroad rails, steel mould-boards and plow-shares, steel gearing and wheels of every size, steel bells of superior quality, either large or small, and all similar work, in green sand, as iron castings are now made, and, by dispensing with all machinery, as cheaply as they are now made of iron. Small specimens of the work, such as can be conveniently carried about, are herewith offered for your inspection.

In addition to the superior qualities of this steel, as shown by the two governmental reports, both as to ducility and strength, our ability to produce it at about the cost of iron, is owing, not only to the inferior irons that we can use, but also to the great economy of heat. By repeated trials, in furnaces where other steels are made by the older processes, we find that we can get out our metal in a little over half the time usually employed in melting. In other words, we save about one-half the heat generally required; and since the price of the fuel is the principal cost in making steel by any process, this saving is a very great point gained. All the older methods depend for melting on external heat. As ours is entirely a chemical process, we depend about equally on external and internal heat, the internal heat being generated chemically, by the action of our ingredients on and with the metal as it melts. Just as cold water thrown into a mass of cold, unslaked lime produces an intense chemical heat, without the use of fire, so the chemicals we use generate an amount of internal heat, about equal to the external heat necessary for the processes of making steel; and when we add together the two savings of both *heat* and *time*, we find that the cost of labor and fuel are reduced to about one-third the cost of manufacturing steel by the methods now in use. That is, the cost of making our steel is about thirty-three per cent of the usual cost. If you add this saving to what we save in using poor materials, such materials as no other process that we know of can employ, you arrive at the ultimate reason why we can make steel at about the cost of good grades of iron; and if you would know why we can run solid castings of steel in green sand, and these perfectly filled out, without honeycomb, blowholes, or seams, it is because the chemicals employed, in proper proportions, eliminate phosphorus, sulphur, and all other injurious substances, and by this chemical heat make the melted mass so fluid that it will run into any opening in the sand, like so much water.

Before concluding this intentionally brief paper, there is a certain prejudice against the use of steel in the place of iron, which I wish to place in its proper light before you. That prejudice is, that steel will not stand frost like iron, and, therefore, cannot generally take the place of iron, however perfectly or cheaply it can be produced. Nothing can be clearer, to my mind, than that this is a prejudice, and by no means a fact. Why should it be a fact? Heat expands, frost condenses, all solid bodies. Iron and steel certainly are so expanded and condensed; but condensation does not necessarily produce brittleness. Condensation ought to increase strength. If it be supposed that it is the frozen moisture contained within the pores of steel that makes the metal brittle, then iron should be affected more than steel, because it is more porous.

But we are not left to *a priori* reasoning on this interesting subject, for it has been put to to the proof by recent experiments made by several of the most scientific men of Europe, that steel is not weakened any more than iron by frost; and, indeed, that the strength of neither is materially affected as to strength by either cold or heat.

In the January number for 1871 of the English scientific periodical called *Nature*, from page 256 to 258, there is a very able paper on the influence of intense cold on steel and iron, and this paper contains the results of many ingenious experiments made by Sir W. Fairbairn, Dr. Joule and Mr. Spence, all of which go to demonstrate that intense cold, and even frost, have no tendency to weaken steel. Dr. Joule's experiments are exceedingly interesting and worthy of the most careful study, and his demonstrations worthy of implicit faith. He says:

"As is usual in a severe frost, we have recently heard of many severe accidents consequent upon the fracture of the tires of the wheels of railway carriages. The common sense explanation of these accidents is, that the ground being harder than usual, the metal with which it is brought into contact is more severely tried than in ordinary circumstances. In order apparently to excuse certain railway companies, a pretence has been set up that iron and steel become brittle at a low temperature. This pretense, although put forth in defiance, not only of all we know of the properties of materials, but also of the experience of every day life, has yet obtained the credence of so many people that I thought it would be useful to make the following simple experiments:

"1st. A freezing mixture of salt and snow was placed on a table. Wires of steel and of iron were stretched so that a part of them was in contact with the freezing mixture, and another part out of it. In every case I tried, the wire broke outside of the mixture, showing that it was weaker at fifty degrees Fahr. than at about twelve degrees Fahr.

"2d. I took twelve darning needles of good quality, three inches long and one twenty-fourth inch thick. The ends of these were placed against steel props, two and one-eighth inches asunder. In making an experiment a wire was fastened to the middle of a needle, the other end being attached to a spring weighing machine. This was then pulled until the needle gave way. Six of the needles, taken at random, were tried at a temperature of fifty-five degrees Fahr., and the remaining six in a freezing mixture, which brought down their temperature to twelve degrees Fahr. The results were as follows:

Warm needles	Cold needles.
64 ounces broke.	55 ounces broke.
65 “ “	64 “ “
55 “ “	72 “ “
62 “ “	60 “ bent.
44 “ “	68 “ broke.
60 “ bent.	40 “ “
Average $58\frac{1}{3}$	Average 59 5-6

“I did not notice any perceptible difference in the perfection of elasticity in the two sets of needles. The result, as far as it goes, is in favor of the cold metal.

“3d. The above are doubtless decisive of the question at issue. But as it might be alleged that the violence to which a railway wheel is subjected is more akin to a blow than a steady pull, and as moreover the pretended brittleness is attributed more to cast-iron than any other description of the metal, I have made yet another kind of experiment. I got a quantity of cast-iron garden nails, an inch and a quarter long and one-eighth of an inch thick in the middle. These I weighed, and selected such as were nearly of the same weight. I then arranged matters so that by removing a prop I could cause the blunt edge of a steel chisel, weighted to four pounds and two ounces, to fall from a given height upon the middle of the nail as it was supported from each end, one and one-sixteenth inch asunder. In order to secure the absolute fairness of the trials the nails were taken at random, and an experiment with a cold nail was always alternated with one at the ordinary temperature. The nails to be cooled were placed in a mixture of salt and snow, from which they were removed and struck with the hammer in less than five seconds.”

The collective result of the experiments, the details of which need not be given, was that twenty-one cold nails broke and twenty warm ones.

Dr. Joule adds: “The experiments of Lavoisier and Laplace, of Smeaton, of Dulong and Pettit, and of Troughton, conspire in giving a less expansion by heat to steel than iron, especially if the former is in an untempered state. Such spectacles of steel wire and of watch-spring as I possess expand less than iron. But this, as Sir W. Fairbairn observed to me, would in certain limits have the effect of strengthening rather than of weakening an iron wheel with a tire of steel.

"The general conclusion is this: Frost does *not* make either iron (cast or wrought) or steel brittle, and that accidents arise from the neglect of the companies to submit wheels, axles, and all other parts of their rolling stock to a practical and sufficient test before using them."

Such are the demonstrations of the most eminent and practical of our scientific men. They put this old prejudice about frost to a crucial test, and it vanishes as all follies vanish before the light of truth; and when we consider that iron is heavy, bulky, cumbersome and comparatively weak, it is evident that it should be replaced, in nearly every department of industry in ordinary use, by steel. Steel is stronger, tougher, more durable under constant wear, and, as we see, no more liable to the accidents of frost than iron; and then, as steel is many times stronger, tougher and more durable, every thing made of it may be reduced many times in size and weight, and remain just as durable as iron, and just as strong and tough.

We propose, therefore, by bringing this new and beautiful process into general use, to revolutionize the business of making steel. The iron age, we imagine, has gone on long enough. We undertake to introduce the age of steel. We have long since been familiar with the power of steam. But steam is too powerful for iron. Our past experience has furnished us with lamentable proofs of the inadequacy of iron to match with steam. Broken rails, fractured car-wheels, bursting boilers, and all the innumerable casualties by which human life has been sacrificed on sea and land, warn us that the match between iron and steam is an unequal one. Steam, in every whistle of our locomotives, in every shout of the steam-pipe of our mighty ships, in every shop and factory all over the world, defies the impotence of iron, and calls aloud for steel. We must heed the warning cry, or suffer the loss of many lives, and lag behind our destiny in the great work of progress, of civilization, in that onward and upward way which Nature and Providence have marked out for man. Let steam and steel be yoked together, and we have a glorious and well-mated span, which, harnessed to the car of human progress, will carry us surely and safely to our destiny!

Our claim is, that, by the use of the iodide of potassium with carbon and the several well-known fluxes, we can convert pig-iron, cast-iron, and all sorts of scraps of the lowest commercial value, into steel of every grade, and make steel castings in every desirable form, and these in green sand, without the delay and enormous outlay of milling, so improving the quality of steel and reducing the cost of it to nearly that of ordinary iron.

Thanking you most earnestly for your attention, I now beg the honor of laying before you some specimens of our work, which, as we fondly hope, will justify to your observation and general knowledge of the subject our strongest expectations and our utmost faith.

Mr. J. K. Fisher.—What is the tensile strength of that steel?

Mr. Atwood.—110,000 pounds to the square inch. Here is a specimen of hammered steel, which has been tested and found to have a tensile strain of 263,000 pounds to the square inch. We have cast steel cannon, the first that were ever cast on this continent.

Mr. Partridge.—What is the cost of the steel in the ingot

Dr Tefft.—About four cents a pound; a little less if anything.

The President.—Is the "Sherman steel process" spoken of in the English papers the same as this?

Dr. Tefft.—It is the same. Mr. Sherman is the nephew of Mr. Atwood.

Mr. Fisher—Ten years ago a tensile strength of 163,000 pounds was extraordinary. In Kirkaldy's experiments, 215,000 pounds were reached, and that surpassed everything that had ever been heard of.

If this will bear 263,000 pounds it must be a great advance in the quality of the steel, whatever its cost. The tensile strength of the Bessemer steel I believe is about 60,000 pounds, as it is cast. But I have seen the statement in an English periodical that in the Sherman process the cost of the iodine is so great as to make the commercial value of the process doubtful.

Dr. Tefft explained that the statement was that *perhaps* it might take a pound of the iodine of potassium to expel a pound of phosphorus, and this *might* make the process costly; and he added: Now the simple fact is that we are ready to take a contract to expel all the phosphorous from all the iron on this continent at eighty cents per ton.

A member inquired if by this process steel could be made directly from the ore.

Mr. Atwood stated that it might be done, but unless the ore was very rich it would be cheaper to make it first into pig-iron.

Dr. P. H. Vanderweyde.—When iodine was discovered, it was considered a curiosity and good for nothing. When I studied chemistry, no use for it had been discovered except that it was occasionally used in medicine. Now it has been called, by Dr. Valentine Mott, one of the greatest boons in medicine; it has been found a great boon in photography; and now we find this new element taking an important part in the manufacture of steel. I have studied the making of Bessemer iron with the spectroscope, and have watched it night after night for four weeks. The great difficulty is to get rid of the phosphorus. Now we are told that the iodide of potassium, which is cheaper than iodine, will expel the phosphorus completely from the steel. From what we have learned of the importance of iodine, what we may not expect hereafter from the new substances, cæsium, rubidium, and other newly discovered metallic elements, when their properties have become known ?

The chemical theory of this process is very plain. Iodine has an intense affinity for phosphorus, and a strong affinity also for sulphur. There is an old chemical proverb, that bodies do not act on one another unless they are liquid, but solid iodine and solid phosphorus will act on one another; and the moment the iodine touches it, the phosphorus will burst into flames. In performing the chemical experiments in the reflection of heat from concave mirrors, so as to ignite phosphorus, it is sometimes difficult to find the focus; but I always take the precaution to have a small piece of iodine handy. (Laughter.)

Dr. J. W. Richards.—Iodine is very volatile. Does it not become fluid before it comes in contact with the phosphorus.

Dr. Vanderweyde.—No; it remains solid until the very moment of contact, when the combustion takes place.

Mr. Wellington Lee.—Is there any difficulty in getting a uniform quality by this process, as in the Bessemer process ? Is it a nice point to determine the time when the process must be stopped ?

Mr. Atwood.—I govern that by having it perfectly killed, so that there is no motion in the crucible. Then if we let it stand an hour longer it makes no perceptible difference.

The President.—Is the amount of iodine used for a given amount of iron a point requiring accuracy ? Is the steel injured by putting in too much iodine ?

Mr. Atwood.—I have put in a triple dose, and could not see any difference. But we must put in enough.

Dr. Vanderweyde.—The excess will evaporate.

The following paper was then read by its author:

CONSTRUCTION OF STREET SURFACES.

By Prof. James A. Whitney.

It is an old axiom with civil engineers that "a good pavement ought to combine stability and moderate smoothness of surface or ease of traction, and be as free as possible from noise and dust." Adopting this as a truism, it is manifest that of the many varieties of pavements now in use there is not one without some manifest advantage, and none without some drawback, the amelioration of which would be a great public benefit. On Broadway we have the firm Belgian, best of all in its capacity for resisting abrasion, but with its interstices forming inequalities in the surface, which result in great wear and tear of vehicles, increased labor on draught animals, and an almost unending uproar; for it must be remembered that a single omnibus or cart in passing over one mile of this pavement is subjected to more than 60,000 concussions, or in an ordinary day's travel of, say thirty miles, to nearly 2,000,000. The noise of the Belgian pavement, and, to a great extent, the severity of the concussive action upon it, is done away with in pavements formed of wooden blocks, which also, in a considerable degree, especially with light loads, lessen the draught. But pavements of wood, although found in Chicago to endure for eight or nine years without relaying, are worn down at the rate of more than half an inch per annum under the crushing impact of the traffic in New York. Nor could any other result be reasonably looked for, when it is remembered that many years. since, at a time when wooden pavements excited the same attention abroad that they are now doing here, it was found by actual experiments in the streets of London that sound hemlock would last but three years, while the endurance obtained with pine was only six or seven. To obtain the smoothness of a wood surface with greater durability and with even greater freedom from noise and jar, recourse has been had to various asphaltic compositions.

The recent experience with the pitch plaster spread upon Fifth avenue, only to be removed after a few weeks' trial, was, perhaps, hardly a fair trial of asphalt pavement, which should be nearly or quite identical in composition with the asphalt or bituminous limestone used for the same purpose in France, and upon which the reputation of pavements of this kind is founded. It is doubtful whether the best French composition, whatever the claims now made in its behalf, has sufficient hardness and tenacity combined to resist the heavy impact of travel in New York streets. As long ago as 1837, a pavement composed of fragments of quartz in lieu of gravel, and cemented together by a very adhesive cement, was laid down in the "Place de la Concorde," in Paris, and being subjected to great travel, proved, in a little while, a decided failure, and was replaced by squared granite blocks. The chief engineer and general director of roads and bridges, in commenting at the time upon this result, tersely stated the cause to be that "the contractor erroneously considered that his bituminous mastic was capable of resisting the direct action of the wheels and of horses' feet." Even when used for ordinary footways, subjected to anything approaching constant use, it was found that the bituminous layer, more than half an inch thick, required renewal every five years. Concrete, therefore, in an even greater degree than wood, must be considered unsuited to the demands of the times as a material for street surfaces, the objection due to its want of permanence being supplemented by the scarcely lesser one arising from the dust produced by its rapid abrasion. Attention is therefore very naturally turned to the possibility of securing, in a measure at least, the advantageous characteristics of ease of draught and comparative noiselessness peculiar to wood and asphalt, combined with greater durability, and with the non-production of offensive qualities of dust and dirt. Even the old cobble-stone, perhaps the worst of all in every respect, save the security of foothold for horses, is for this one merit still retained between the tracks of our street railways, and a hint of the manner in which the paving of city streets may be best fitted for the duty required of it, is given by the custom common among cartmen of driving the horse between the rails with at least one wheel running upon the track. To provide a pavement which will afford the firmest grip for horseshoes, and at the same time the smoothest running way for wheels, would, as nearly as is possible, meet the requirements of ordinary vehicles in traffic and transit in city streets. This, for a brief period, is said to have been realized by an enterprising omnibus company in London, who changed the gauge of their vehicles to correspond with that of the tramway then recently laid down in the English capital. In this case, however, the parties, although they succeeded in showing the utility of the iron wheel-ways constituted by the rails, were promptly estopped by an injunction from interfering with the exclusive right to the track vested in the tramway company.

Increased ease of draught and security to draught animals, as already intimated, are the two all-important essentials of a superior pavement. The former not only enables a given number of horses to draw a greater load at the same speed, or the same load at a more rapid rate, but, from the nature of the conditions necessary to secure this, also insures a diminution of noise and decreases the deterioration of rolling-stock. A good hold for the feet of horses manifestly permits the smoothness of the running way to be utilized to the utmost, either for speed or power applied to propulsion, and also avoids the great liability to sudden and serious loss from the slipping and falling of horses upon the pavement. We may, therefore, here consider, first, the relative values of different kinds of pavement with reference to the economy of draught power; second, the varieties best adapted to provide the requisite foothold for the animals by which the power is furnished; and third and lastly, the most feasible method of combining the best examples of the two in the least costly manner, and with the least interference with pavements already approved as in actual use in our streets.

The resistance of roadways or pavements made of different materials, and according to various plans, has been the subject of very careful research, especially abroad, and the results attained come verified as the dicta of the most eminent English engineers. According to these, a tractive power equal to 100 pounds, continuously exerted, will draw on a level road as follows: A common gravel, 1,500 weight; macadam, 2,700; granite pavement, 3,500, broken stone surface laid on an old flint road, 3,400; same on a rough stone pavement, 4,800; wood pavement, 5,400¾; a stone pavement of more than ordinary uniformity, 6,700; and a common iron railway track, 27,600 pounds.

Of these examples, the gravel road, may be taken as equivalent to an average country road in good weather, and is of no interest in this connection. The macadam, still used in suburban districts, but objectionable from the grinding of its surface into dust, need not, for the reason just indicated, be further considered here. The granite and stone pavements, as will be seen from the above data, gave results superior to the macadam as far as traction is concerned; but when laid in blocks, possessed all the manifest defects of our present stone pavements; and when of broken stone laid on sub-pavements, or foundations, those inherent in the macadam. The wood, affording, when properly laid, the surest footing for horses, shows also very high merit in point of non-resistance to tractive force, but, as several times intimated in the present writing, fails in point of durability. This, a serious defect, can only be partially remedied by the most judicious selection of material, and the greatest care in preparing and laying down the blocks. The permanence of wood pavement may, however, be measurably increased, by causing the abrading action of the wheels to be received by some material capable of affording a minimum of resistance to the wheels, and at the same time so constructed and arranged as to permit the travel of the draught animals for the most part upon a surface more especially adapted to them. This is, indeed, only the principle of the horse railway, but for common use in streets must permit the turning out of vehicles from the ways; and hence, instead of rails, tramways flush with the surface must be used. The advantage of a system of street construction based on this method has long been conceded, but has heretofore failed in practical as it has succeeded in experimental trial. Stone tramways, described as consisting of two parallel lines from eighteen to twenty-four inches each in width, made of blocks about a foot in depth, and with the space between the two lines, or tracks, filled in with pebble or cobble stone, were in use abroad many years ago. One of these, laid from the India docks to Whitechapel, London, in 1829, was stated to have given the most advantageous results as far as reduction of draught was concerned, and similar stone tramways were used by Telford, whenever, in crossing hills, the grade exceeded one in twenty, while still other tests showed that by their adoption, a single horse, upon a level, was enabled to draw a weight of ten tons.

The blocks were either laid upon a broken stone, or upon a sub-pavement previously prepared for their reception, although the opinion has been expressed by some, that if the stones were of considerable size a bed of gravel would furnish sufficient foundation. The size and consequent cost of the stones, however, combined with great amount of labor required in handling them, would render this style of tramway out of the question for general use. According to a report made by a committee of the Franklin Institute in October, 1843, the stones for such a tramway should not be less than two feet wide, one foot thick or deep, and from four to eight feet long. Aside from the expense of transporting, shaping and laying stone blocks of such dimensions, it is evident that the smooth surface, two feet wide, of each track or way, would promote the slipping of horses and injure ease of draught at the expense of safety to the animals employed. An obvious substitute for stone is iron, and as the writer will herein have present occasion to explain, this material undoubtedly provides the requisite essentials of a tramway system for streets in greater perfection than any other. But hitherto the few actual trials made of it for such a purpose have been so inadvisedly carried out as to prove only the great reduction in tractive force, secured by it in the moving of a given load upon a given incline. Of such was the iron tramway laid in the streets of Glasgow, Scotland, nearly thirty years ago. It was formed of cast-iron plates about two inches thick and eight inches wide, was laid upon stone supports, and up a grade of one in twenty. One horse could draw four tons with ease. As with stone tramways, this method of construction fell into disrepute on account of the cost, and also, we may presume, because the smooth iron surface presented no adequate hold to the animals attached to the vehicles. The durability, smoothness and freedom from dust undeniably belonging to the system, were not sufficient to prevent it from falling into disuetude, where, like many another idle germ of a useful improvement, it has remained almost the lapse of a generation.

At the present time, when the subject of street paving has become a matter of so much professional importance to engineers, and of so much financial consequence to the public, the proper method of utilizing iron for such purposes is worthy of the most serious attention. Having mentioned, though briefly, the comparative merits of different pavements and of various materials, as applied in tramway construction, the writer may pass to an equally brief consideration of what appears the most practicable means of securing all the essentials of a superior street surface, however great the traffic and travel thereupon. Such would be found in the use, preferably in connection with a wooden pavement of iron tramways, laid flush with the street surface, and so constructed that, while affording projections to keep horses from slipping upon them, smooth longitudinal ways will be furnished for wheels to run upon. The advantage of this is evident when we recall the enormous disproportion between the weight drawn by a tractive force of 100 pounds on an iron track and that moved by the same power on any other of the various kinds of pavement previously herein specified. Estimated roughly, this difference is so great that one pair of horses can draw a load over a smooth iron tramway which on an ordinary macadam or turnpike would require from seven to nine pair of draught animals.

Reasoning *a priori* from the basis just presented, it would seem that the best results would be achieved by providing a street with iron tramways, preferably two, for travel in opposite directions, the portion of the surface not occupied by the tramway tracks to be covered with a wood pavement. This latter, nevertheless, would not be essential, and in most instances it would, doubtless, be desirable to leave the present pavement undisturbed, except so far as absolutely necessary in laying the tramways.

In the preceding remarks the writer has set forth in general terms the elements of a new system of street improvement, and the principles upon which the same is based. It is the invention of Samuel D. Tillman, well known as professor of technology in the American Institute, and chairman of the Polytechnic Association. With regard to the precise manner in which the improvement is to be carried out in practice, the writer cannot do better than to quote, in brief space, Prof. Tillman's own description of its peculiar and essential features: "Employing iron as the material for the wheelways or tramways, I would," he says, "cast it in hollow blocks, so as to be interlocked, and its face could be provided with a series of smooth raised surfaces, alternating with impressions or indentations, and the raised surfaces could be so arranged that the wheel would be constantly sustained on a true grade by rolling over one raised surface, which should touch the middle of the tire, or rolling over two raised surfaces, which either simultaneously or alternately, would give a bearing to the wheel-tire near its sides. The transverse depressions thus formed allow the toe-cork or fore part of a horseshoe to sink below the raised or grade surface, and by means of such surfaces the horse would find a sufficient bearing against which to exert the leverage of his foot. A pair of iron paths each about one foot wide, and placed four feet and a third apart, would provide a tramway suitable for vehicles of various widths, embracing the pleasure carriage, cart, lumber-wagon and omnibus, and a pathway for a pair of horses between such tracks. The tramway could be made of hollow cast-iron blocks, each about a foot long, with a projection on one end and a recess on the other, so that when brought together and interlocked, the pressure on the edge of one block would be transferred to the center of the next. Such blocks could be laid directly on pure sand, or be filled in from beneath with wood and laid on a perfectly solid and smooth foundation. The tramway could also be constructed of longer wrought-iron or cast-iron plates having longitudinal ribs or webs underneath to strengthen them; each resting securely, by means of spikes, on one-half of the top of a wooden post set in the ground, and reaching below the action of frost. This plan would give a permanent pathway for the wheel, independent of that for the horse, and also would be unaffected by any changes which the surrounding earth might undergo by the action of water or frost. The face of such tramway could be composed of alternating smooth elevations and depressions, of a series of narrow ribs running longitudinally, or of a smooth surface having on it one or more lines of elevations and depressions, so arranged as to provide a foothold for horses, and, when placed on the edges of the tramway, to allow wheels to pass obliquely over without sliding"

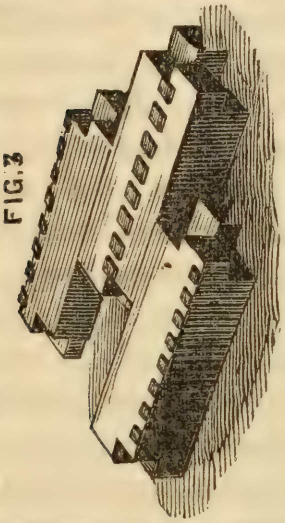


FIG.3

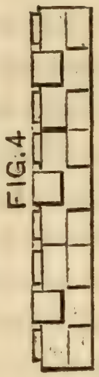


FIG.4

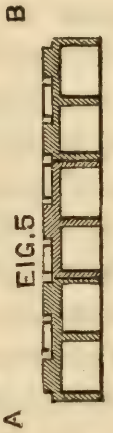


FIG.5

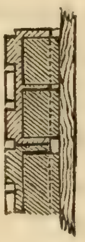


FIG.6

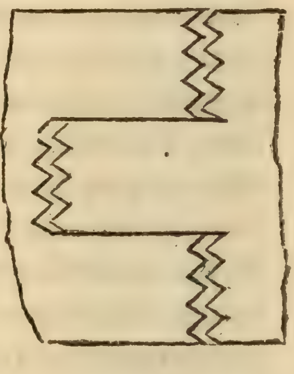


FIG.7

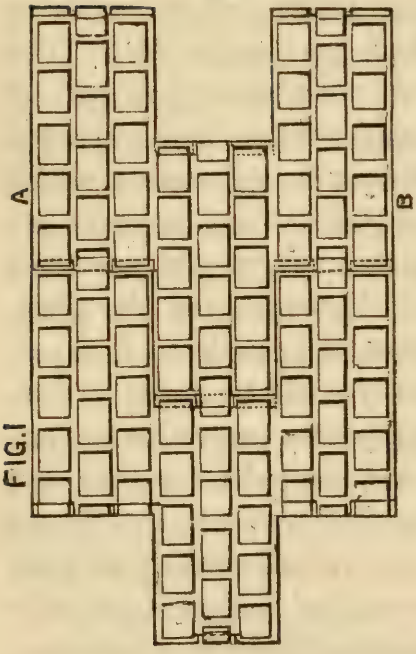


FIG.1

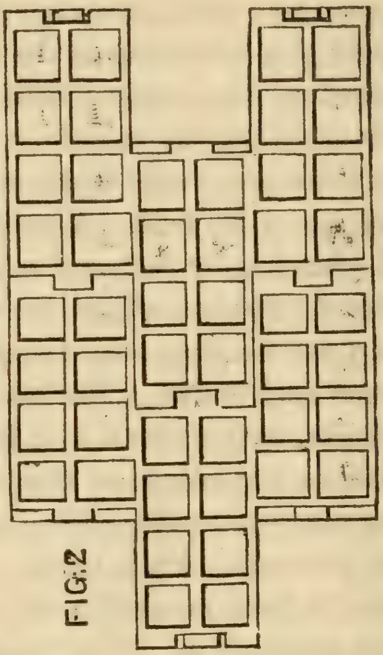


FIG.2

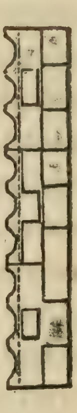


FIG.8

It will be seen that the precise means employed in carrying the system into practice may be modified in many ways, but those which are thought preferable were represented in the illustrations herewith shown. Each block is formed with two lateral or wing-like portions, and a central and tongue-like portion, as represented in the perspective, Fig. 3, in such a way that when fitted in line with each other, as shown in the plan, Fig. 1, and inverted plan, Fig. 2, the central tongue of one will fit between the wings of the other. These mutually support each other against superincumbent pressure, even when exerted at the edges of the blocks. This support is, furthermore, aided in a degree by lugs, A^2, provided in such a manner as to jut into recesses or seats suitably arranged in the edges of the adjoining block. The upper surface of each block is grooved in such a way as to afford a foothold for horses, and at the same time, from the disposition of the grooves and of the raised surfaces between, furnish a bearing which shall be continuous upon some part of the periphery of the wheel passing over the same. The under side of each block, as indicated in Fig. 2, is made of somewhat cellular form by longitudinal and transverse partitions which constitute braces to give the requisite strength against vertical pressure, and also by their hold upon the sand, concrete, or other foundation, to prevent lateral displacement of the track. An end view of one of these blocks is given in Fig. 4, and a transverse section in Fig. 5, An end view is also represented in Fig. 6, but in this the elevations that afford bearings for the wheels are wave-shaped or ridge like, with rounded hollows or partially cylindrical channels between the furnished foothold, this being more especially adapted for vechicles with rounded tires. In Fig. 7, is shown a top or surface view of a modified method of locking the tongue of one block with the latteral wings of the one adjoining. Fig. 1, shows a modification in which is used a block, having either a smooth surface or one made up of very minute elevations and depressions, which will not provide any definite hold for the calks of horseshoes. In such cases the locking tongue and wings may be substantially the same as in the others, but are furnished with upright and supporting blocks, B, and bed, C, of wood. It is also proposed by the inventor to apply the same system of iron paving-blocks to the construction of pavements covering the entire surface of the street, in cases where a pavement of such character is preferred.

Such, we remark in closing, are the essential features of an improvement by which it is proposed, at a fraction of the cost of any kind of pavement in use, to increase its utility many times by diminishing the power of draught required in moving vehicles through the street and also to promote the greater permanence of the pavement itself, by causing the abrading action of the wheels to be received by the smooth and comparatively indestructible metal, instead of by granulating stone or soft or slowly decaying wood .

Adjourned.

March 30, 1871.

Prof. S. D. Tillman in the chair; Robert Weir, Esq., Secretary.

The following paper was read by its author:

SUBMARINE WARFARE.

By Robert Weir.

The monitor type of war-vessel has been proved the most formidable, and, as far as invulnerability is concerned, the most perfect, of naval craft, for the purposes intended; namely, to give and receive blows above or near the surface of the water. They present the least surface of exposure to the shot or ram of an enemy, and that surface, being small, is most readily protected with armor of almost any required thickness. These very important facts were practically demonstrated during our late war, and since the close of that eventful strife other nations are adopting the system. In England and France they tried to adopt the monitor with the broadside system, with an apparent intention to avoid anything that should be purely American in their plans, and the result has been an enormous expenditure of money, with no adequate returns. And, but lately, a sad casualty happened to one of this nondescript class of war-vessels. A heavy lurch in an ordinary storm at sea, and the top-heavy craft went down, carrying with her her crew of about 500 souls. (Early on the morning of the 7th of September, 1870, H. M. S. Captain foundered off Cape Finisterre, with almost all hands on board, only eighteen men having been saved out of her crew of upward of 500 souls.)

With our monitors our heavy guns will also be imitated, and we must prove ourselves equal to the emergency. Resting satisfied with our success above water, we may turn our attention to operations below the surface; here is the vulnerable spot, the heel of Achilles, which has been left undipt, that the remaining part of the body might be certainly made impregnable.

During the past eight years there have been many developments made in this important arm, and it is now universally adopted as a necessity both for military and naval purposes; regularly organized torpedo corps being employed by the different great nations of the world.

Our own government has adopted systems, part of which are known to the general public; but the latest performances of the corps are enveloped in that mistaken secrecy which the zeal of an enemy has but little trouble in ferreting out. We have adopted one system which has worked well in experiment, and which will, in actual practice, prove very effective. This is the torpedo-craft designed and built by Engineers Wood and Lay, of our navy, a description of which may prove interesting. We will take the first one of this class, which was built and known as the "Spuyten Duyvil." Her length is eighty-four feet, breadth twenty-one feet, depth of hold ten feet. The torpedo machinery weighs about ten tons, while her propelling machinery weighs about two and a half or three tons; her deck is something like a monitor's, having smokestack, ventilators and pilot-house visible. Her armor is about five inches in thickness. In the bow is an air and water-tight chamber, which can be opened and closed by a valve worked by gearing. The valve and gearing are contained in a water-tight casing connecting with the interior of the chamber. An operating bar made of boiler iron is arranged to run out and in through this chamber by a universal stiffening box joint, as it may be termed, which allows the bar to be pointed in different directions. The rear end of the bar is connected with a chain to a drum near the water-tight compartment, while the forward end connects with a chain to a drum in the compartment; by means of these chains the bar is run out and in as desired. On the end of the bar is a case to receive the torpedo shell. The case being in the water-tight chamber, which has the water previously pumped out of it, the torpedo is placed within it, and pushed back so as to be clasped by jaws which are on the end of an inside rod to the bar. The chamber is closed, and the operating bar is now ready to run out. As you are now near the enemy, the propeller is stopped and reversed, the driving machinery is started, the drums revolve and run out the operating bar. When it is fully extended, the action of the drums is simultaneously reversed, and the operating bar quickly run back into the vessel. So soon as the bar begins to travel back, the rear end of the inside rod comes in contact with a trip, which stops its progress, while the motion of the bar continues. This check to the inside rod causes the torpedo to be pushed out and released from the casing, being only connected thereto with a cord. Its buoyancy now causes it to rise against the bottom of the enemy's vessel. The cord being now distended from the backward motion of the torpedo craft and machinery of the bar, it releases a pin which has sustained a weight in the inside of the torpedo. This weight falls upon a percussion cap and the explosion is made. The torpedo is a special feature in itself; the shell is divided into two chambers by a yielding wad or diaphragm of wire gauze; the larger chamber contains the explosive material.

the other is merely an air space to give direction to the explosion. A tube is placed in the center of the shell, in one end of which an iron ball or weight is held in position by a pin, which, when withdrawn, allows the weight to fall upon a percussion cap placed on a nipple at the opposite end of the tube. A cord is fastened to the releasing pin and coiled in a recess of the case which holds the torpedo.

The rebel iron-clad Albermarle was destroyed by the use of one of these torpedoes, projected from an ordinary steam launch. On the night of the 27th of October, 1864, Lieut. Cushing came within 100 yards of the ram before he was discovered and hailed. He then had to describe a semi-circle with his little craft, in order to strike the Albemarle fairly. He drove at her under a full head of steam, striking and pressing in the fender of logs which surrounded the ram, and at the same time ran out the spar and placed the torpedo under the enemy's quarter. It could have been scarcely six feet beneath the surface of the water. At this instant a gun was fired from the ram, and the intrepid Cushing pulled the cord and exploded the torpedo. In a moment his little craft was swamped and he and his brave companions left in the water to perish or save themselves as best they might.

Our government has made many important improvements upon these first inventions, by which their operation is greatly simplified and rendered more perfect in its effects, without the slightest risk to the operating vessel. A number of torpedoes can be projected from the craft as she passes the enemy's ships, and this can be done without arresting the speed or changing the course of the torpedo-boat, as readily and as accurately as though firing a broadside of guns.

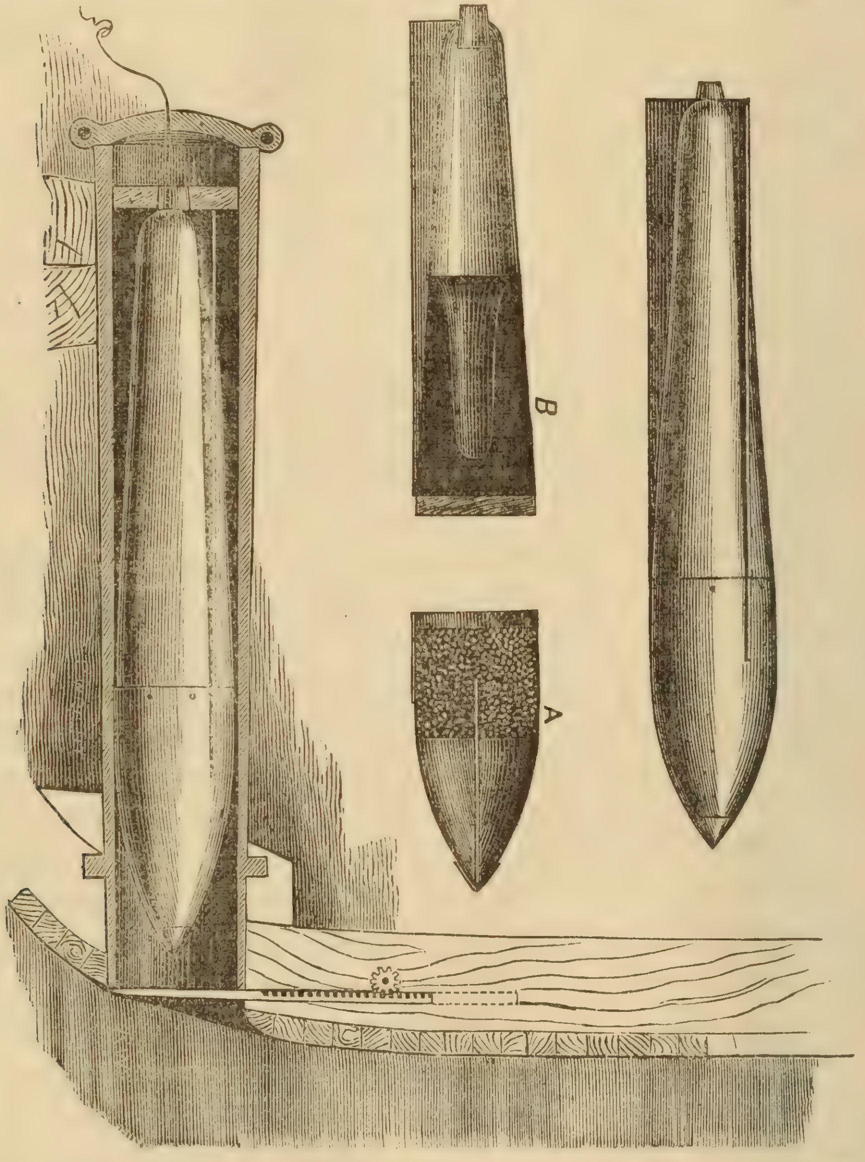
The English have adopted a torpedo known as the "Otter," and invented by John Harvey, of the Royal navy. This is a wooden case strengthened with iron, and containing the shell or torpedo within it. It is about ten feet long, seven feet deep and two feet wide. A cable is attached to this in such a manner, that when towed from a vessel it can be made to diverge from her course at any angle under forty-five degrees. To compel this machine to hug the side of an enemy will require a great excess of speed in the assailing vessel, and would be very clumsy to manage under any circumstances, though England prides herself in now possessing a machine which is very sailor-like in its action, and therefore well suited to the use of seamen. This torpedo is operated from the torpedo craft, either by lines reaching it for that purpose, or by electricity or contact with the enemy. Russia, being alive to all improvements, has accepted this system, though it is generally understood that she has a better, and one similar to the "Austrian torpedo." This is propelled by compressed air working propellers; its depth in the water is regulated by a horizontal rudder worked by hydraulic pressure, the water acting upon a diaphragm of India-rubber, which is compressed or expanded, according to the depth of immersion. This pressure is utilized so that the rudder can be set to retain a certain position for the torpedo, according to the depth the operator may wish to strike an object. The use of compressed air in this manner has its disadvantage.

Mr. John Ericsson, a man upon whom all Americans look with pride, has brought before the public numerous ideas in regard to submarine warfare which are worthy of much consideration. One of his propositions is, that the torpedo shall be driven by propellers worked through rotary engines driven by air supplied from the ship through a flexible tube which the torpedo tows out from the vessel's side as the pressure works the propellers, the torpedo to be guided by a greater or diminished allowance of air as the tube is reeled off. The life of the torpedo would depend upon the length of hollow cord, which would probably be liable to a complication of derangements.

Mr. Ericsson's last proposition is to throw elongated shells from guns of large calibre at moderate ranges, say 1,000 or 1,500 feet, letting them dip into the water just before reaching the vessel to be struck, and continuing their course to come in contact and explode well below the water-line. These shells are to contain 200 pounds or more of dynamite. This scarcely seems practicable, as we are by no means up to the emergency arising from the use of such bolts.

I now have a proposition of my own, which I will respectfully place before you, a style of torpedo which I have experimented with to a limited extent, but which has proved itself quite feasible.

This torpedo is really a submarine rocket, a slow burning powder being used to supply the propelling power, while the construction may be justly characterized as plain and simple, the device being composed of only two parts, viz., the exploding shell, or torpedo proper, and the rocket, or propelling shaft. Both parts can be made of copper, zinc, sheet-steel, or thin boiler iron. In the first place we have the torpedo, or exploding part of the projectile. This is shaped like an ordinary rifle-shell, to present a surface of least resistance to the water. The apex, when the apparatus is in use, consists of an easily ignited percussion fulminate, covered with a thin film-like coat of copper, covering several inches of the point of the shell, so that contact with any part of the front will ignite the charge. The shell is then filled with the exploding powder through a hole in its base. Then the rocket, or shaft-projector, a hollow, tapering shaft made of thin, strong material, to be filled with slow burning powder. On the outside, and at equal distances apart, are three wings or keels, set on the same line as the axis of the projectile. The small end of the shaft has a contracted opening, through which the gas of the rocket-powder in the chamber is to act in propelling the torpedo. This shaft is loaded with a large rocket, or the rocket-powder is rammed into it, as in a rocket-case, leaving a central opening, of large surface, for the burning powder which is mixed with a greater proportion of charcoal to insure the necessary action.



When filled, the large end is securely stopped with a carefully fitted plug or sabot of wood, and is then set into the lower rim of the shell, where it fits snugly. It can be secured in this position by screws, which join all parts together with strength. The weapon is now ready for use; and, as it must be projected from below the surface of the water, a gun or guide of sufficient strength, and of simple construction, can be secured in the vessel's side, or bows, eight or ten feet below the water-line, as needed. This will have an outboard and inboard, or breech valve. To load; the outboard-valve will be closed, and the inboard opened; the torpedo will be carefully run into the chamber to a marked distance. A thick wooden sabot, with a hole turned in the center of it, just large enough to receive the projecting tube of the shaft, is then placed against the swell and wings of the instrument, fitting snugly in the bore of the gun, and leaving a space of several inches between itself and the inboard-valve. A friction primer is now set in the tube connecting with the slow burning powder; the wire from this runs through the inboard-valve, which is now closed, and the outboard-valve is opened, admitting the water freely around the torpedo to the sabot. The instrument is now ready for use. Possibly, it may be necessary to assist so large a body in starting. This can be done by mechanical means. After firing, which is directed from deck, the outboard valve is closed, and the inboard-valve opened, allowing the water from the gun to run into the hold of the ship, and another torpedo can be placed in position, etc. This operation of loading and firing will consume no more time than has been occupied in its description. The torpedoes being made, and cased ready for use, are stored in the magazine like loaded shells.

Any vessel can be armed with these torpedoes, for the construction of the gun or guide is comparatively simple; the power which forces the projectile from the gun, being contained in itself, will necessitate but little trouble in handling.

One of our monitors, armed with three or four of these guns on a side, could well defy the navies of the world. In numerous experiments which were made to test this principle, its success was quite apparent. The first trial was made with the shell of the torpedo constructed of light pine wood, a little over two feet in length and three inches in diameter at the center, being turned to the shape of a spindle. This was cut away in the inside to admit of an ordinary government rocket, with lead for ballast. It was weighted so that the specific gravity was a little more than that of water, so that when it was placed in the water it would slowly settle to the bottom, retaining an almost horizontal position. The after or near part of this spindle was provided with three wings of tin, placed equidistant from each other, and in a true line with the spindle axis.

It was fired from a water-tight wooden box guide at a depth of two feet below the surface of the water, by means of a friction primer, the spindle being packed in the guide at its center with stiff tallow, in order to exclude the water from its after part. The torpedo started almost instantly from its position of rest, and travelled most satisfactorily, making a distance of sixty-three feet in five seconds, and striking the target at a point three feet to the left of the point aimed at, and two feet ten inches below the surface of the water. This excess in depth was attributed to the lightening of the after part of the spindle by the burning away of the rocket powder, which would cause that part to lift.

Many other experiments were tried, all of which clearly demonstrated the principle. I found that in giving the wings or keels a spiral shape, in order to rotate the torpedo like a rifle shell, the tendency was to retard and lift the projectiles to the surface of the water. The best results were gained by the use of the Hale rocket principle, the rotation being caused by the direction of the propelling gases, thereby leaving a perfectly clear and smooth surface to the whole apparatus, or in having keels of thin material on the same line as the axis of the spindle.

This projectile could be used at any distance under 250 yards with great effect, being made large enough to contain 250 pounds of composition for generating the gas for propulsion, and about 200 pounds of explosives. A little practice with the above short range would enable an operator to hit an object without fail, and leave him free from the fear of being "hoisted with his own petard," as is so apt to be the case where close contact of the operator is required.

It will be seen that the velocity of these projectiles will depend upon their shape and sectional area, as well as the powerful action of the generated gas. They must be well and carefully proportioned, their length being not less than six times the diameter. Torpedoes, for the use of ships, could be made about eighteen or twenty inches in diameter, containing from 175 to 200 pounds of explosive powder; and, for harbor defense, they might be made two feet in diameter. One of this latter diameter would be twelve feet long, and, being made of scant one-quarter inch boiler iron, the weight of the entire shell would not exceed 600 pounds. The displacement of water would be nearly twenty cubic feet, or 1,234 pounds, leaving 634 pounds for the explosive and propelling powders. Three hundred and forty pounds could be used for the generation of the gas, and three hundred pounds for the exploder; but for harbor defense, nitro-glycerin could be used, and thereby reduce the size of the torpedo considerably; and by reducing the size of the shell, and lengthening the shaft proportionately, such a mixture could be used as would generate a tremendous pressure of gas for the propelling force, and by reducing the time of travel to a minimum, insure better results. In some of the experiments which were tried, the velocity attained by this means was astonishing. The projectiles were made of tin, and about ten diameters in length, with carefully pointed heads of wood, the whole length being three feet, and propelled by twenty-ounce rockets. They looked like living fish under the water, darting in a true line with as great velocity. To perfect this arm, experiments must be tried on a large scale; possibly they might be made considerably heavier than water, and used on the principle of rockets; that is, to start them with an elevation approaching the surface of the water midway in their course to the enemy, and gradually sinking towards the end of their course, strike and explode.

Their use can certainly involve but little detail in the construction of the guns or guides, for, when the torpedo is ready to be fired, it is no more weighty than water; and to start it, compressed air could be admitted behind the sabot at the moment of firing. This sabot in starting becomes a piston, which receives nearly all the starting pressure. It keeps the water from contact with the gases in the gun, which would otherwise be partly reduced or condensed; and, on compressed air being suddenly admitted, the powder will burn freely, and the inertia of the mass be gradually and delicately overcome. As the sabot leaves the mouth of the gun it meets water at rest, and the onward motion of the torpedo frees it, when it will rise to the surface. The delicate cap on the end of the torpedo will cause the explosion if it strikes at any angle outside of about thirty degrees from its own line of course, so that the enemy may be struck in any position. It is within bounds to say that these torpedoes could be made to travel thirty-six feet a second, or at the rate of twenty-five miles an hour. In this case, if an enemy is 250 yards distant, it would require about twenty seconds to reach her. This tardiness will certainly require some dead reckoning on the part of the operator; but practice will soon give him complete control of the machines, so that, whatever may be the intervening tides or currents, or the swift motion of the enemy's vessels, he would be able to strike home, say nine times in ten. Three hundred pounds of composition, requiring about twenty seconds to consume, would give a tremendous power fo the propulsion of one of these projectiles.

However, the real value of this principle can only be reached by actual experiment on a large scale. As far as I have been able, I have experimented, but only with ounces of powder where tens or hundreds of pounds should be used, and should this arm prove a success, which I firmly believe will be the case, we shall have a most formidable weapon for harbor defense. Our heavy and expensive ordnance can be done away with, and fortifications will be looked upon as monuments of the past. Small floating iron-clad batteries could be moored at intervals across a harbor's mouth, and, armed with these torpedoes, and the calcium light for night work, could render any seaport impregnable.

Mr. C. L. Emery.—Have you means for directing your gun under water?

Mr. Weir.—Yes; I have an arrangement, not for depressing or elevating it, but giving it a range of at least sixty degrees fore and aft.

Mr. Clinton Roosevelt.—How does your plan differ from Fulton's plan of submarine torpedoes?

Mr. Weir.—The experiments he tried were with an ordinary gun or cannon, I think. He would set the gun in position when the tide was low, and when the tide was up he would fire it off. He had also a torpedo, which he tried in 1812 to be screwed on the bottom of the enemy's vessel and to go off by clock-work.

Mr. Roosevelt.—Commodore Rogers challenged him to blow him up, and he could not do it. The British government justified the fitting out of coal transports to supply the Alabama, because our government gave me protection to go out to Russia during the Crimean war with my torpedo. My plan was to have the torpedo on a shaft that could be let down on approaching the enemy, and elevated when we did not wish to use it, placed on the bow of the vessel. The battery was made very sharp and long, so that the inclined plane would deflect the shot. I offered that to our government in 1835, and it is noticed in the Washington *Globe* of that year. I believe that is the first proposition for such a steam battery ever made to any government. I was requested to come to Russia, but did not go until the Crimean war was nearly closed. I claim to be the first to propose a practical plan for deflecting balls by an inclined plane. I think we shall have to come to that system at last, to have very long vessels, to go bows on and back off, because no armor can be made thick enough for protection against a shot striking squarely. The first monitor made by Ericsson they did not dare to try a second time. The Merrimac, which was built somewhat after my plan, came out and challenged her, but she did not dare to accept the challenge. Ericsson continues to make the turret larger and larger, so as to get the advantage of a long inclined plane. Commodore Rogers found, on the Mississippi, that the balls flew off from a vessel upon my plan, just as they do from an alligator's back.

Mr. Weir. — The Keokuk, which was destroyed off Charleston, was made with a deflective battery. Ericsson has not attempted to make deflecting sides, but makes his turrets larger to accommodate larger guns.

Mr. Roosevelt. — Those he has made for his own country are made oblong.

The President. — Mr. Bushnell, of Connecticut, was one of the earliest experimenters; long before Fulton, I think.

Mr. C. L. Emery. — I do not know that reminiscences of the war are in order; but it may be interesting to state some of our feelings when we were blockading the Mississippi river in the early part of the rebellion, when we had nothing but wooden walls, and were expecting a formidable iron-clad down the river. In the discussions that took place among our officers at that time, it was considered unfair to come down with vessels of such a character. Why not come down in a wooden vessel, and have a square fight? We could not help regarding with a feeling of dread an iron invulnerable vessel, which could fire at us without running any risk; and we thought it was unmanly for them to attack us without giving us a fair chance. It really seemed dreadful, and created more discussion than going by the forts at New Orleans. That was merely a rush to get by and take as few shot as possible. And when we had passed those tremendous forts, where the shot and shell was fearful — for there was probably more noise, and probably there were more shots and shells flying in the air at that time than at any other during the war — after all that, when we saw that little vessel steam out, it created more consternation among us than the whole engagement at New Orleans. But when we made up our minds what to do, and the Mississippi was sent to run her down, she was run ashore and abandoned. I only mention these facts to show how these new features of warfare strike one at the time, and how much more formidable they seem than they really are. It is undoubtedly true that a well-constructed iron vessel cannot be destroyed by a wooden vessel, unless it is so small that it can be run over, which was one of the plans we adopted at Fortress Monroe, when it was the design to run down the Manassas; but the captain of the wooden vessel was too much afraid of his wooden walls to attempt it. The system of torpedoes seems to be the only one by which an iron vessel can be destroyed. They may be made invulnerable above the water, and, if well manœuvered, cannot be run down, except by vessels of a much larger size. This plan seems to me one of the best for that purpose; for it furnishes the means of propulsion under water. The *vis viva* of a shell is soon destroyed by its passage under water, so that, if you fire it from a gun and depend upon its momentum, you will be disappointed. This torpedo has within itself the propelling force, the rocket powder, which will carry it to its desired destination.

A gentleman (Mr. Roosevelt) spoke of having been the first to propose inclined iron surfaces. In my travels I have found many persons who claimed to be the first, and who undoubtedly were the first, so far as they knew, to propose certain improvements. I remember, in Chesapeake Bay, the captain of a vessel who claimed that the Merrimac was built just according to his design. About a year before he had designed the vessel, and sent the plan to our navy department; but they paid no attention to it. Years and years before anybody imagined that iron boats could be used, he proposed iron plating, with inclined surfaces towards the enemy; and he proposed one feature which was certainly novel — that, just before action, the seamen should go round and slush the plates all over, so that the shots would slip off.

Mr. Roosevelt. — I challenge anybody to produce any record before mine.

Mr. Weir. — Mr. Ericsson has a patent, dated in 1832, for a monitor made with the sides inclined. It was made to look like a turtle's back.

Mr. Roosevelt. — My battery can be made to run so fast as to be of some service. Ericsson's could not run fast.

Mr. Emery. — The gentleman certainly deserves a great deal of credit for his plan, for that plan was used on western rivers during the war.

The Secretary read the following paper by Dr. Feuchtwanger, the author being detained at home by illness:

ZINC AND ITS COMPOUNDS, THEIR USES IN DOMESTIC ECONOMY AND MEDICINE.

By Dr. Lewis Feuchtwanger.

Zinc has of late years become one of the most useful metals in domestic economy, and for utility must rank next to iron. For manufacturing purposes where copper was formerly employed, zinc often now takes its place. The various manufactures of zinc, are castings and galvano-plastic productions, household utensils and conveniences, such as baths, vessels for culinary purposes, also for signs; for alloys, coating other metals, for the production of electro-galvanic and electro-magnetic instruments; also for galvanizing iron, copper and brass; as a substitute for lead in roofing houses. In place of bronze in casting statues and other objects of art, both on a large and small scale, this metal offers considerable advantages. The effect of zinc castings, whether with a surface of zinc or with another metallic coating, is of great interest, considering particularly their cheapness and comparative lightness, so as to be the means of forming cheap duplicates of objects of high art existing in the more costly materials of bronze or marble.

The use of zinc for preventing the oxydation of iron, its aptness for perforation, and its general application to domestic purposes, are all well known. It is obvious that on many accounts it may be advantageously applied to a large extent, especially in cases where the unyielding character of iron, and the high cost of copper, present obstacles to their use. It cannot be doubted but that zinc will before long be employed for statuary and the casting of small groups of figures and ornaments. Among the late improvements in printing, zinc has lent its powerful aid through the invention of zincography and heliography. The first refers to a process by which ancient or modern engravings, and also modern impressions and drawings, executed either with the pen or the pencil, are transferred to a zinc plate, by a peculiar ink is employed for the purpose; not only is a perfect fac-simile of the original obtained, but copies to any extent of this fac-simile of the original thus obtained, and copies to any extent of this fac-simile are again produced, at an exceedingly moderate price and all of equal excellence. Every kind of drawing can be executed in this ink, and it has therefore this great advantage, that it enables artists at once to fix and reproduce their sketches, instead of having recourse to lithographing, wood-cutting or engraving on metal, and the most rapid and evanescent expression of an artist's thought may thus be corrected, without impairing the spirit of the original sketch in the process of transfer.

Heliography is one of the latest inventions in photography, effected by transferring the picture obtained on the zinc plate and etching it by means of acids, and then exposing it for a time to the rays of the sun and submitting it to a secret process before printing. The picture on the frontispiece of my work on gems was thus executed in this city, and is pronounced a success.

Zinc has been known to the Chinese for a long time; it was brought to the notice of the Europeans in the sixteenth century. Native zinc, in its metallic state, is extremely rare. It has been found in a basaltic rock in Australia, near Melbourne, but it is found in great abundance, in combination with sulphur and called blende, or with carbonic acid, smithsonite. With silica it is called the silicate or electric calamine, on account of its being pyro-electric; when combined with oxygen, it is the red oxyd of zinc, usually found in foliated masses and of a deep red color. It is found in connection with franklinite, which likewise contains, iron and maganese, in New Jersey, the only locality in the world

Zinc has also been detected in the vegetable kingdom, in a peculiar violet flower growing on the calamine hills of Rhenish Prussia.

Blende, calamine and the red oxyd are used for reduction in the various works of England, Germany, Spain, Hungary and the United States. The name blende is derived from the German word *blind*, a name given by the miners, who were deceived by it when looking for lead and copper; they met with this ore, which they considered worthless. It is also called *black Jack* by the miners.

Besides the last-mentioned ores are a number of minerals found in many localities of the world, which contain more or less zinc in combination with other interesting substances, such as the following:

A mineral called hopeite, found in the calamine mines of Aix-la-Chapelle on the Rhine, which is a phosphate of zinc.

Aurichalcite is a rare mineral from Spain, which contains zinc and copper.

Greenockite or cadmium-blende is often associated with zinc ores.

Goslarite, from the Hartz mountains, is a mineral consisting of the sulphate of zinc and water.

Köttigite, a mineral from Saxony, contains zinc combined with cobalt and arsenic.

Hydrozincite is also called zinc bloom, and is mostly found as incrustation in the zinc mines.

The metals which accompany the zinc ore without altering its physical character, are cadmium and indium. The first was discovered by Stromeyer in 1817; the latter was discovered by Reich in 1861, by means of spectrum analysis, as it imparts a blue color to flame and its spectrum is characterized by two indigo-colored lines.

Both these interesting metals are only found in zinc ores, more particularly in blende.

The localities of zinc ores are very numerous in every part of the world, and mostly in the neighborhood of lead mines, with a few exceptions. In the United States zinc blende, both yellow and black as well as calamine, are found in great abundance in Maine, New Hampshire, Massachusetts, New York, New Jersey, Pennsylvania, Missouri and Wisconsin; more particularly in the last five States; also in Virginia, in Wythe county, where the calamine has been mined and exported to Europe.

The principal smelting works for the production of the metallic zinc called spelter, when brought to market in the form of inch thick plates, and in sheet form of various thicknesses, and in wire of various sizes, are in England, Belgium, Silesia, Hungary, Spain; and in the United States, in New Jersey (Newark), Pennsylvania (Bethlehem), Missouri and Wisconsin. The methods applied for the reduction of the various zinc ores differ much according to the materials used in the work. Blende is mostly employed in Silesia, the carbonate or smithsonite in England, while in the United States the calamine and the red oxyd are mostly used as reduction materials. The theory is very easily explained, and is based on the fact that zinc ores when exposed to great heat are very volatile, and easily converted into vapors, which are led into coolers, whereby they are condensed into solid metal. In Silesia, the process of reduction is pursued in the following manner: The ores are roasted in large open furnaces for several hours; oxydation ensues, they are then transferred into muffles made of fire clay, which are placed in a receiving furnace, previously, however, mixed with coal dust. The muffles having the shape of retorts with necks, lead the rising vapors into small cooling vessels; there are ten muffles which fit in one reducing furnace, and require twelve tons of coal to reduce one ton of the metal, at which operation forty per cent is driven off from the original weight of the ore.

The Belgian process is somewhat different; the operation being performed in earthen tubes of three feet in length, and four to five inches in width, which hold about forty pounds of the roasted ore; a cast-iron pipe is then attached to each tube, when, after exposing them to the red heat in a large furnace, the metallic zinc condenses in them and is drawn off every two hours.

The English process is executed in covered crucibles, which are placed in a circular furnace, like a common glass furnace, which is heated by a single fire place in the middle, but openings in the bottom, into which a conical tube of sheet-iron is introduced, to which end a large sheet-iron tube is attached; in this the vapors of the zinc are condensed while being led into water. Coal is used in England, while coke is employed in Belgium for reduction. The crude zinc or spelter obtained by these various processes is not quite free from impurities and other metals adhering to it, such as lead, cadmium, arsenic, carbon, etc., all of which cannot be got rid of without another distillation; the crude metal has to be dissolved in a dilute mineral acid, and precipitated by carbonate of soda; the precipitate mixed with purified lampblack, and then redistilled in earthen retorts

The physical characters of zinc are the following: It is a bluish-white metal, of a peculiar taste and of perceptible smell when rubbed; of a crystalline structure; at ordinary temperature, brittle, but when heated to 130 degrees, may be rolled out in sheets, and when heated to 300 degrees, becomes again brittle, so that it may be broken up and pulverized; it has a specific gravity of 6.8, and its equivalent is 32.99, and its symbol Zn; it fuses at 773 deg. Fah., boils at bright heat, and then volatilizes; it takes fire in the presence of atmospheric air, and burns with a luminous greenish flame, forming the oxyd of zinc, which was formerly called flowers of zinc, or philosopher's wool. When zinc is exposed to moisture it remains unaltered; for this quality it is so much used in the household for other purposes, such as roofing, business signs; galvanized iron, such as nails, spikes, chains, cables, and ship furniture, which is effected by merely dipping those various articles in melted zinc, is in great use, as it protects them from rust, corrosion and destruction. With tin and mercury it forms an amalgam and excites electricity; it is also used for obtaining hydrogen gas by means of sulphuric acid.

The most important of the zinc alloys is brass; when some tin is added to the copper and zinc which forms the brass, it is bronze; when nickel is added to the mixture of copper and zine, it is called German silver, which forms a beautiful white composition; while brass, bronze, and other alloys form yellow compositions of all shades, from bright yellow to brown red.

Zinc combines also with lead and tin, and hardens them; but does not harmonize with bismuth, and hardly with arsenic and antimony.

The importations of spelter and sheet zinc from Silesia, Belgium, and England, are very extensive, as may be seen from the custom house report of the city of New York, where it it stated that in the last three months we imported, of spelter alone, 130,173 plates, of twenty-eight pounds each. We may fairly compute the importatio of spelter at 3,000,000 of pounds; of sheet zinc over 2,000,000 of pounds, and over 2,000,000 of pounds of oxyd of zinc, or white zinc paint. In Missouri, the spelter has been produced for a year past; also in Wisconsin, but not in sufficient quantities to interfere yet with the large importation. In Bethlehem, Pennsylvania, spelter has been manufactured in considerable quantities, which has been pronounced superior to the English and Silesian spelter. Sheet zinc has not, to my knowledge, yet been produced in the United States; it is extensively imported from the Vieille Montange works, in Liege, in Belgium.

Sulphate of zinc, called white vitriol, is a mining product; a soluble salt, which crystallizes in long prisms, and forms a series of double salts with alkaline sulphates. For medical or other chemical purposes, it is dissolved in water, boiling the solution with oxyd of zinc, and then recrystallizing the sulphate. White vitriol is much used in the arts, and also in medicine, as a powerful emetic, particularly in cases of poisoning, where prompt action is indispensable.

Carbonate, acetate, iodide, bromide, cyanide, and other salts of zinc are usefully employed in medicine, but not in the arts. The compounds of zinc are all poisonous, but not to the same extent as those of lead; sufficiently, however, for the oxyd of zinc, now used in painting in place of white lead, to be capable of producing colic resembling that from white lead. It is called also the *colica pectorum*, for it attacks workmen exposed to the dust of the oxyd, while engaged in packing it in barrels; it yields, however, to the same treatment as the lead-colic.

The alloys of zinc with copper and with nickel, and also that of copper and tin, deserve, on account of their great importance in daily life, more than a passing notice.

Brass, which is composed of copper and zinc, was formerly made from copper scraps or clippings and calamine, or from blende and charcoal; latterly the method of casting brass has been changed into the following mixture: fifty parts old brass, fifty granulated copper and twenty-five zinc melted in sand, or black lead crucibles, about sixteen inches deep, are exposed to a white heat in the well known air furnaces for four hours, and the fleece brass poured out in iron moulds with the precaution of stirring the mixture, before pouring, with an iron rake, in order to bring any light foreign matter to the surface, and instead of iron moulds, granite blocks are used. Its composition will then be two equivalents of copper to one of zinc, or the formula $Zn\,Cu_2$; but according to the various purposes for which the brass ingots are used, such as either for transforming to sheet brass or wire, the proportions are altered; a little iron hardens it and diminishes its tenacity and malleability; tin renders it harder and stiffer, even one-half per cent alters its ductility; lead imparts to brass a harshness, which renders it unsuitable for the lathe.

The gold-yellow color of brass and the various proportions of zinc changes its colors; tombac is a red brass, and contains eighty-two per cent copper and eighteen per cent zinc, and Dutch metal or foil, or spurious gold leaf, which is a pale yellow brass hammered out into leaves, contains a small portion of zinc. The Lyons and Sporzheim gold, wrought up in jewelry, is nothing but brass, but subjected to a peculiar treatment, which consists in heating thin copper bars or wire in earthen tubes with zinc, the fumes of the latter uniting with the copper externally.

Brass solder is prepared by two parts of brass melted with one part of zinc. Brass, when tempered, diminishes in density and increases in bulk in proportion to the copper, and has a specific gravity of 8.20 to 8.95, and it expands from thirty-two degrees to 212 degrees. Good brass melts at twice the temperature of red heat, which is about 1,869 degrees Fah.

Bronze, proper, is an alloy of copper with tin. It is now generally known by the names of antique and modern bronze; the former consisting of copper and tin, while the latter contains also the zinc, and sometimes no tin at all, so that modern bronze is but a brass with an excess of copper. Bronze, when exposed for a length of time to atmospheric agents, assumes a peculiar greenish or olive hue, arising from the formation of a basic hydrated and carbonated oxyd of copper.

This color is very attractive. For attaining this result many experiments have been made. Generally any salt of copper, dissolved in water, or weak acid, is applied to the surface with a brush, or the objects are immersed in the solution in which portions of verdigris and of sal ammoniac are dissolved. Vinegar, fine oxalate and nitrate of potassa, with blue vitrol, are likewise used for the purpose; the tint of colors may be varied by the mixture of saltpetre, common salt and sulphuric acid. A solution of palladium chloride with black lead and peroxyd of iron, has been successfully employed for bronzing, and it is said to produce a fair and permanent coloring.

Argentan, or German silver, is the other alloy above alluded to. It is said to have been manufactured in China, under the name of packfong; in Germany, since 1824, and in this country was first introduced and manufactured by me in 1833, from the copper nickel. This alloy is composed of copper, nickel and zinc in certain proportions, varied in whiteness or softness according to the uses for which the composition is intended. The proportion which I used for a white and soft metal to roll out in sheets, was fifty per cent of copper, twenty-five per cent of nickel, and twenty-five per cent of zinc. In order to prevent any loss of zinc by volatilization, it is well to mix the same with the copper, which is put on the bottom of the crucible and the nickel on top, so that when the red heat begins to soften the copper, the nickel, which is more refractory, also becomes soft and melts.

The quality and adaptation of German silver vary with the proportion of the metal and the purity of the nickel. I have teaspoons, which have been used in my house since 1835, and look like old sterling silver. Examine these pennies, of which I issued in 1837, with the permission of the United States government, over 1,500,000 pieces, made with the properties above given, and you will acknowledge that this composition challenges the silver for wear and durability. The new nickel cent which contains but twelve per cent of nickel has more the appearance of old brass.

German silver is now very extensively used for spoons, forks, and other domestic utensils, and as castings for philosophical, mathematical and surgical instruments, gun mountings, harness and carriage furniture, etc., etc., etc. If the nickel is pure, the composition will wear very well; it should, however, not be used in vinegar or with acid fruits, and its surface should always be kept clean and bright. It is far less likely to prove injurious than articles of copper and brass, and it may well be substituted for them.

Dr. F.'s paper was illustrated by specimens of the heligraphic art, of metallic zinc, cadmium and indium; also of brass and bronze; his German silver cent, issued in 1837, resembled a sterling silver old coin. Minerals containing zinc, such as the blende, calamine, smithsonite, aurichalcite, and the red oxyd of zinc, and of the most important chemical and medical preparations, such as the white oxyd of zinc, or zinc white, the chloride of zinc, sulphate of zinc or white vitriol, acetate carbonate, and bromide of zinc were also exhibited.

Adjourned.

April 13, 1871.

Prof. S. D. TILLMAN, in the chair; ROBERT WEIR, Esq., Secretary.

The Chairman read the following notes of scientific progress:

SPONGY IRON AS A FILTER.

Voelcker calls attention to the use of spongy iron as a deodorizing material of greater potency than animal charcoal. Sewage water passed through a filter of spongy iron is completely purified, and this water, after having been kept six months protected from the air, was perfectly sweet and free from fungus growth. The spongy iron was obtained by calcining a finely divided iron ore and charcoal.

Mr. Thomas D. Stetson.—One of the great virtues of animal charcoal lies in the facility of restoring it and making it almost as active as before. If this iron can be used but once, it will be a great drawback upon its usefulness. The deodorizing property of any filter continually grows less, until it is saturated. We can then subject animal charcoal, for a certain length of time, to a pretty high heat, and it is revivified. Sugar refiners do not give the same price for it, because it is not as active as fresh coal; but it is nearly as active. If this iron cannot be treated in that way, it would be an objection to it. But if it were more active in deodorizing or discoloring than the best wood or animal charcoal, it would be very important in the arts.

Dr. P. H. Vanderweyde.—Animal charcoal deteriorates so much that after a great number of reburnings they sell it, and it is used for manure on account of the phosphate of lime in it. Wood charcoal is not so porous, and it soon becomes choked up. When petroleum began to be used for lubrication, it was necessary to remove the impurities in it by filtration. To accomplish this nothing has been found better than animal charcoal. For this purpose, the charcoal may be reburned oftener than in refining sugar, because the pores get filled with lime from the sugar. In the reburning of the charcoal, it is put into a retort and the petroleum is distilled out of it before it is burned.

VENTILATION OF HOUSE-DRAINS.

The *Builder*, in reviewing the report of the Royal Sanitary Commission, says: "The basis upon which a system of ventilation of drains must be effected, is the consideration that sewage consists of two fluids, the one liquid (the sewage proper) and the other gaseous, the foul air liberated by the decomposition of sewage; and as these two kinds of fluid travel in opposite directions, the one downward, by gravity, and the other upward, by reason of its having less specific gravity than the atmosphere (at least some of the component gases have, and those most injurious to health), it follows that, to construct a channel merely for the one part, without completing the work by providing an exit for the other, is to make an imperfect work; for as the formation of gases cannot be prevented in the sewers and drains, they will accumulate in the higher parts of the drains (and those are in and close about the houses), until their elastic force drives them through the traps and soil-pipes into the houses, unless a ventilating pipe be so connected with the drain as to carry off these injurious gases. A plan which has succeeded is to carry up from the head of every house-drain, a pipe of three or four inches diameter, to the top of, and a few feet above the highest part of the roof of the house. The eruption of the confined gases will not then tend to force themselves through the traps, but will freely ascend the channel provided for them, and when they make their exit from the mouth of the pipe above the roof, they become sufficiently diluted with atmospheric air to become harmless to the dwellers below, for they have the tendency to still further ascend, until, indeed, they become practically annihilated."

The Chairman.—This subject has been agitated a good deal in England since the death of Prince Albert. It will be recollected that the fever he caught was owing to a defect in a drain pipe near the window of his sleeping room.

Mr. J. K. Fisher.—In an office in which I was engaged sometime since, the gas bubbled up through the water trap so that the room was scarcely tenable. I suspected that the mischief was caused by the *Herald* office exhausting steam into the sewer. I have seen in several places steam pufling from the sewers, showing that steam-engines are exhausted into them. If the sewage passes rapidly through the sewers, there will be less foul gas, and it will be less injurious in quality. There is a general want of engineering skill in the construction of sewers and in the laying of drain-pipes. They do not discharge as rapidly as they should, and they are often not made of suitable materials.

The Chairman.—I have no doubt that one of the chief causes of disease in this city is the foul air passing off from the sewers.

Dr. J. S. Diehl.—It appears that the ancients were cognizant of the necessity of the ventilation of sewers. The Temple of Belus, supposed in the days of Herodotus to be the Tower of Babel, and 225 feet high to-day, is ventilated by parallel perpendicular flues connect ing with a subterranean passage leading to the river. In all the old cities there are regular sewers from four to six feet apart, which constitute a perfect system of ventilation. The Pyramids have flues running up and down, connecting with the water, and the water connects through a subterranean passage with the Nile. In all these great works they ventilate their sewerage, carrying off the gases. The Arabs, where they do not have these, keep their mouths shut, which is the secret of health.

Mr. T. D. Stetson.—There is an excuse for our New York city sewerage, that it has been built by piecemeal. We have had a succession of political changes as the city has extended gradually northward from the Battery, and we have had a succession of engineers, no one of whom has had nerve enough or confidence enough in his tenure of office to go to work and tear up the streets of New York to lay down a new system of sewers. They have been content with amelioration, instead of radically changing the system that they found there. As to exhausting steam into the sewers, I am confident that if it could be proved and brought to the attention of the Croton Board severe measures would be taken to prevent it.

The President.—Certain portions of our city were built up without being properly drained. The natural courses of the water both above and underground were stopped by foundation walls at certain places, and these are now centers of disease.

Dr. H. D. Sheppard.—When there is a heavy rain at the time of high water, and the ends of the sewers are under water, the traps are often entirely incompetent to restrain the air, and it will sometimes come back with so much force as to scatter the contents of the sink all over the room connected with it.

Dr. Vanderweyde.—When the New York Medical College, in Thirteenth street, was in existence, there was a piano factory which exhausted its steam into the sewer, and it caused us much inconvenience in the dissecting room. We supposed it was an unavoidable evil, and submitted to it; but it was a great nuisance.

ORCHILLA.

One of the most precious colors known to the dyer is that produced from a kind of moss which grows on bushes and stones near the sea. Its existence in Lower California has lately been discovered. It is so abundant along much of the coast that one person can gather a quarter of a ton in a day. The best quality brings in England about $300 per ton. The dye from the orchilla, or achilli, as the English call it, furnishes a color that is said to rival that made from the cochineal. Plantations where the cochineal insect is bred have become unprofitable for several years, in consequence of the competition of the orchilla colors produced from the linchen brought from Africa.

FUNGUS THE CAUSE OF WHOOPING-COUGH.

Dr. Letzerich, the pathologist, who some time ago published his observations on a fungus, supposed by him to produce diphtheria, has more recently made a series of experiments with another form of fungoid growth, which he believes to be the cause of the very infectious disease, whooping-cough. The spores found in the expectorated mucus, causing the irritation of coughing, were allowed to vegetate into large masses, and small portions were then introduced into young rabbits by an opening in the windpipe. The wounds thus made soon healed, but the animal became affected with a violent cough. Several animals thus diseased were killed, and the air-passages in each were found to contain very large quantities of similar fungus. These observations, so important to the advocates of the germ theory, have not, as yet, been confirmed by other investigators in the same field.

PRODUCTION OF IODINE.

A method invented by Thiergelin has been successfully used in extracting iodine from crude Chili saltpeter. The mother liquors, resulting from the manufacture of saltpeter, are treated with a mixture of sulphurous acid and sulphate of soda, and the iodine will be precipitated as a black powder. This is placed in earthen jars, on the bottom of which are layers of quartz-sand, fine at the top and coarse at the bottom. From these jars it is removed by earthen spoons lined with gypsum, and the greater part of the water is thus separated. It is further purified by sublimation, but is often sold before undergoing the last named process. The amount of iodine thus reclaimed from Chili saltpeter already amounts to 30,000 pounds per annum. As the removal of all traces of phosphorus is essential in the conversion of iron into steel, the use of crude Chili saltpeter in the converting crucible would doubtless prove valuable in removing phosphorus as well as other impurities.

IS INSTINCT INHERITED EXPERIENCE?

Prof. J. Le Conte, of the California University, in a recent letter to Prof. Tyndall, of London, on an optical illusion, says: "Whether the seeing of objects in their true position be in man a primary or an acquired faculty, may, perhaps, always be a vexed question. My own belief is, that it is partly the one and partly the other; that a capacity is innate, by virtue of which the very complex knowledge involved in vision is rapidly, almost immediately, acquired. The actions of all animals are determined partly by experience and partly by instinct. But instinct itself is, probably, but an inherited capacity, improved by the experience of thousands of generations; a sort of inherited experience. In insects the wealth of inherited experience is great, and of individual experience is small; while in man the reverse is true. I think that no one can doubt that a new-born chick or a new-born ruminant sees objects in their true position. Is it improbable, then, that in man, also, erect vision is partly the result of inherited experience, though confirmed and strengthened by individual experience; the former inherited through all human generations, or even, perhaps (Darwinians would say.), through all vertebrate generations?"

MAGNECTIC SPECTRA.

Professor A. A. Mayer, of Pennsylvania has invented a new method of fixing, photographing and exhibiting magnetic spectra. He first coats a clean plate of glass with a solution of shellac in alcohol, in the same manner as a photographic plate is coated with collodion. After the plate has remained a day or two in a dry atmosphere it is placed over the magnet, so that the under surface of the plate just touches the magnet. Fine iron filings of Norway iron, which has been repeatedly annealed, are now sifted uniformly over the film of lac. The spectrum is then produced on the vibrating plate by letting a light piece of copper wire fall vertically upon it at different points. The plate is now cautiously placed on the end of a cylinder of pasteboard, which serves as a support in bringing it quite close to the under surface of a cast-iron plate, which has been heated over a large Bunsen flame. Thus the shellac is uniformly heated, and the iron filings sink into the softened film. When the shellac is hardened it fixes the spectra. When photographic prints are to be made from the plate, the heat is allowed to act until the metallic lustre of the filings has disappeared, and the film appears quite transparent; but when the plate is to be used as a magic lantern slide the heating is not carried so far. Many plates have been made by this process, showing the action of single magnets of various forms and of juxtaposed bars, as well as the effects of electric currents led by wires through holes drilled in plates. Among the most interesting are those spectra exhibiting the inductive action of magnets on bars of soft iron, and the interaction of magnets and electric currents.

THE AROMA CONDENSER.

Mr. N. Hotz exhibited and explained the Aroma Condenser, for coffee and tea-pots. It consists of a vessel of cold water placed above the coffee-pot, and containing a spiral tube which communicates with the steam from the coffee, and with the open air above the cold water; the steam being condensed in this tube. Care should be taken that the coffee does not boil too rapidly. There should be no perceptible odor from it. If boiled slowly, it will be more than two hours before the cold water will become so heated as not to condense the steam.

Mr. T. D. Stetson.—The great point in cooking coffee is to maintain the temperature at boiling heat for a certain length of time. All the steam that escapes is simply superfluous. If we could so manage our fire as to keep up that temperature without producing steam, this apparatus would be unnecessary. If very little steam is made, the water in the condenser will be very slightly heated. But if the coffee-pot were to be placed on a red hot surface, the escaping steam would soon heat the water, and would warm a whole barrel of water. Properly used, this mode of saving the aroma is very successful. Condensers have been made with straight pipes. Those would be less effective; but housekeepers might find difficulty in washing out this spiral pipe.

Mr. C. D. Boyle.—A very ingenious mode of cleaning such a pipe was invented by Mr. Palmer, the sculptor. He passed a cord through a series of balls, soft upon the outside, and passed them through the pipe.

NEW FAUCET.

Mr. Hotz exhibited and explained a self-closing faucet, which is durable and proof against injury by frost. A valve is held by a spiral spring upon its seat, with sufficient force to balance the water pressure. A slight pressure upon a lever compresses the spring and allows the water to flow. There is a provision for holding the lever in three different positions, if water is to run slowly or rapidly for considerable time.

Mr. Hotz also exhibited a hydrant upon the same principle and general construction.

Also, a hose-pipe, containing two adjoining diaphragms with circular openings at one side, so that turning the pipe, by bringing tne openings either exactly or partially opposite each other, will regulate the amount of flow.

NEW VENEERS.

Mr. Overton exhibited veneers of wood cut by a new shingle machine capable of cutting 1,000 shingles per minute from the green log, without steaming or other preparation. The shingles are slightly curved, which is regarded by the inventor as an advantage; for usually shingles are curved upward by exposure to the sun and rain, and these being laid with the concave side down, the curvature resists the tendency to curl up in the ordinary way. The log of wood rotates against a stationary knife which cuts a continuous shaving.

The following letter was received, with a request that it be inserted in the proceedings of the association:

NEW YORK, *April* 13*th*, 1871.

Prof. Samuel D. Tillman, Chairman Polytechnic Association:

DEAR SIR.—As no member of our company was present at the meeting of the Polytechnic Association, held October 13th, 1870, we beg leave, by way of explanation, to state that, notwithstanding, as Dr. Parmelee stated, the melting points of tin and lead do vary, yet, practically, there is no difficulty in soldering our improved tin-lined lead pipe, which is now made double its original weight, equalling the weight of ordinary lead pipe of same size. In the early stage of its manufacture, some plumbers did experience a difficulty in wiping the joints, but this has been overcome in the improvement above referred to, and they now certify that they can wipe a joint on tin-lined lead pipe, as easily, and as safely as they can on lead pipe.

The same difference between "theory and practice" exists in relation to the expansive properties of tin, and lead, as evidenced in tin-lined lead pipe. We could cite numerous instances, but the following will suffice, which was given anterior to Dr. Parmelee's remarks:

"*To the Colwell's, Shaw and Willard Manufacturing Co:*

"GENTLEMEN.—You ask us how we are pleased with the tin-lined pipe furnished our hospital, in the early part of the year 1870. Our building was at that time plumbed throughout with your tin-lined pipe, both for *hot* and cold water, which has continued to give us the greatest satisfaction both for purity, and durability.

We have had no occasion for the services of a plumber since the pipes were introduced.

Augustus Geisler, Supt. German Hospital,
cor. East 77th street and Fourth avenue.

New York, *July 3d*, 1870."

Yours respectfully,
COLWELL'S, SHAW, & WILLARD, MF'G. CO.

Zinc Ores.

Dr. Feuchtwanger exhibited additional specimens of zinc and zinc ore, in further illustration of his paper read at the last meeting. Also, specimens of cadmium and indium, extracted from zinc ores. We have three manufacturing establishments in the United States. The manufacture of the white oxyd of zinc is now increasing, and we are already beginning to export it to England.

The Mediterranean Sea.

Dr. P. H. Vanderweyde exhibited a map which he had prepared to show the territory drained by the Mediterranean sea. There are a great many lakes, especially in Asia Minor, in the neighborhood of the Mediterranean sea, scores of them, which have no outlet, but, like the Dead sea, evaporate all the water they receive. The Mediterranean sea receives very little drainage, and is in a climate where there is a great deal of evaporation. The Black sea, on the contrary, is in a region where the rain-fall is much greater than in the United States, and receives the waters from many large rivers; and it has a large surplus of water, which it pours into the Mediterranean sea. In addition to this, the Mediterranean receives water from the Atlantic ocean, flowing inward through the straits of Gibraltar, to counterbalance its evaporation.

It is now stated that there is an undercurrent flowing outward through the straits of Gibraltar. That must be secondary to the main current above, and may be caused by differences of specific gravity, as the currents of air flow in at the top and out at the bottom of the door of a heated room.

Dr. I. S. Diehl stated that there appeared to be more water discharged at the delta of the Nile than came down over the cataracts, and asked Dr. V. how he accounted for that.

Dr. Vanderweyde.—In the first place I should want to be sure of the fact.

Dr. Diehl.—I cannot give the authority. The French expedition claims to have made this observation.

Mr. Hudson.—Is the current through the straits of Gibraltar constant and uniform? I should think it would be extremely variable.

The Chairman.—In the winter season the undercurrent is undoubtedly stronger than at other times.

COLD LINES IN THE CALORIC SPECTRUM.

Dr. Vanderweyde.—As astronomers have been discovering new asteroids by the telescope, chemists have been discovering new metals by the spectroscope; but thus far we have not kept pace with the astronomers. These new substances are cæsium, rubidium, thallium and indium. If we transmit the rays of the sun through a prism, we see the seven colors of the rainbow. If the rays are received through a narrow slit, the colors are separated, and dark lines appear in the spectrum. Fraunhofer not only discovered these lines, but that they are different in the spectra of stars from those in the spectrum of the sun. It is found by Bunsen, Kirchoff, and others, that these lines are peculiar to certain substances; and they have made elaborate investigations of the lines produced by various substances. But they found some lines they could not account for. In order to determine what produced these lines, they selected, first, certain lines in the blue rays, and by various experiments they found they could remove the substances producing the other lines and at last isolate the substance producing those particular lines. They then found that this substance was a new metal, which, from its lines being in the blue, they called cæsium. In the same manner they found another substance producing certain lines in the red rays, and that they called rubidium. These substances resemble potash and soda. Other investigators found thallium and indium. There are still lines in the spectrum unaccounted for; and we do not know what new substances may yet be discovered.

The principal lines in the spectrum were indicated by Fraunhofer by the letters A, B, C, etc., up to I. But when we came to photograph the spectrum, we found that the red, orange and yellow rays, with the lines A, B, C, and D, could not be photographed. The spectrum commenced in the green, and not only continued up through the blue, but far beyond the blue, and in that portion of the spectrum were scores of new lines. Photography continued the lines K, L, M, etc., up to U, and that is as far as it goes now. It may go farther by and by. In the visible spectrum there are lines which are not luminous, and so in the chemical spectrum there are lines which have no chemical action.

By the themometer we find that the rays in the blue and green are quite cool; that in the yellow they are warm, in the red they are hot, and beyond the red they are hotter still. Nine-tenths of the rays we receive from the sun are heat-rays, and only one-tenth are light-rays. The question arises whether there are in the caloric spectrum cold lines, as there are dark lines in the luminous spectrum, and as there are lines where there is no chemical action in the actinic spectrum. But the thermometer is not sufficiently delicate to detect such lines. I therefore tried the thermopyle, consisting of bars of bismuth and antimony, the whole instrument being but one and one-half inches long, and capable of measuring exceedingly small amounts of heat. I so arranged it that after setting a wire in the eye-piece of the telescope, upon a particular line, the eye-piece could be removed and the thermopyle introduced exactly in the place of the wire. In that way I tested the apparatus upon the lines A and B, and I found in each case, that upon moving the thermopyle in either direction, the needle moved, showing a less amount of heat in those lines. I then continued the investigation in the space where we have only heat rays; and I found there also sudden motions of the needle. I found a prominent cold line at the same distance outside of the line A, as that line is from the line D.

This result has been, in a most unexpected and most gratifying manner, confirmed by experiments of an entirely different nature. Becquerel made investigations of fluorescence, which is to light what echo is to sound. Substances put in a strong sunlight were found, when removed suddenly into a dark place, to glow; and some substances will glow for half an hour, or even fifty minutes, while others cease almost immediately. He found that the caloric rays had no effect in causing fluorescence, but that it was caused exclusively by the chemical rays. On the contrary, he found that the heat rays had the power of annihilating fluorescence. Keeping the substance for a single second in the red rays, or in the heat rays beyond the red, the fluorescence was extinguished. After exposing a substance which had been made fluorescent to the spectrum of the heat rays, he found that where the dark lines were the substance remained luminous, and he thus saw a luminous line as far from the line A in the heat spectrum, as that line is from the line D, that being a cold line which had not the power of extinguishing the fluorescence.

OBSERVATION OF THE SUN.

Dr. Vanderweyde continued: In connection with this subject, I will state that a new plan has been devised for getting rid of the heat rays in observing the sun. The rays of light falling upon a right-angled prism in the usual manner are totally reflected. If they fall less obliquely upon the second face of the prism, they will be refracted and pass through. Now the angle at which total reflection takes place depends upon the degree of refrangibility of the light. Consequently, the angle is different for the more refrangible violet rays from that for the less refrangible red rays, or the still less refrangible heat rays. The prism may be so adjusted that the red and all the visible rays shall be totally reflected to the eye-piece, while the less refrangible heat rays will be refracted and pass through the prism. The observer, moderating the light by a colored glass, and relieved of the heat, can observe the sun for hours without inconvenience, receiving only luminous rays.

Mr. Boyle.—I have had a dark glass break by the heat, under my own eye, while observing with a prism.

Dr. Vanderweyde.—The angle must be exactly at the limit. If you make the inclination too great, the heat will be totally reflected as well as the light. Looking in the prism at the proper angle, you will see an arc showing the limit of total reflection of light; that arc is the limit, where the caloric rays will pass through the prism, and the luminous rays will not.

Adjourned.

April 27, 1871.

Prof. S. D. TILLMAN, in the chair; ROBERT WEIR, Esq., Secretary.

The Chairman read the following items of scientific news:

COLORING MARBLE.

R. Weber states, in *Dingler's Polytechnic Journal*, that acoholic solutions of perchloride of iron are not precipitated by carbonate of lime, and may therefore be applied to white marble for the purpose of imparting to it a yellow color. The depth of the color will depend on the degree of concentration given to the solution.

PICRIC POWDER.

Prof. Abel, chemist to the British War Department, has, after prosecuting numerous experiments, succeeded in perfecting the new explosive agent recently produced by him under the name of picric powder as a material for charging shells. Although it is not so violent in action as gun-cotton, nitro-glycerin or picrate of potash, picric powder is a much more powerful explosive than gunpowder, and has other properties which appear to render it peculiarly adapted for employment in shells. Its merits are that it may be readily and expeditiously prepared, and that it is remarkable for its safety as compared with all other explosive agents, being somewhat less sensitive to ignition by percussion than gunpowder. The president of the committee of explosives at Woolwich, having pronounced the new powder worthy of further experiment, it will be tried under various conditions in order to ascertain its suitability to the requirements of the service.

Palatable Cod Liver Oil.

Dr. Hager finds that the addition of ten drops of chloroform to 100 grammes of cod liver oil renders the latter agreeable to the taste, without in the least impairing its medical qualities.

Solder for Iron, Steel and Brass.

Dr. E. Dingler has tested the efficacy of an alloy for soldering iron to steel, or either of these to brass. This alloy consists of three parts of tin, thirty-nine and one-half of copper, and seven and one-half of zinc When applied in a molten state it will firmly unite the metals first named.

Oxydation of Iron.

Dr. F. C. Calvert describes, in a paper read before the Manchester Literary and Philosophical Society, a series of experiments for the purpose of ascertaining the conditions under which iron is most rapidly oxydized One of the important points arrived at is that carbonic acid promotes oxydation of iron. He also substantiated the curious fact, first announced by Berzelius, and now well-known to soap and alkali manufacturers, that caustic alkalies prevent the oxydation of iron. Calvert's researches prove that the carbonates and bicarbonates of the alkalies possess the same property as their hydrates; and that if an iron blade is half immersed in a solution of these carbonates they exert such a preservative influence on that portion which is exposed to common air, that it does not oxydize even after a period of two years Similar results were obtained with sea-water, to which carbonates of potash and soda had been added.

A REGISTERING SPECTROSCOPE.

William Huggins described, before the Royal Society, a registering spectroscope devised by him, and constructed by Mr. Grubb, optician, of London. The short duration of the totality of solar eclipse suggested the importance of some method by which the position of lines in the spectrum of a corona might be instantly registered without removing the eye from the instrument, so as to avoid the loss of time and fatigue to the eye of reading a micrometer-head, or the distraction of the attention and other inconveniences of an illuminated scale. The object is accomplished by fixing a pointer in the eye-piece of the spectroscope, to move along the spectrum by a quick motion screw. The arm of the pointer is connected by a lever with a second arm, to the end of which are attached two needles. These needles move over about two inches when the pointer is made to traverse the spectrum from red to violet. Under the extremity of the arm is a frame fitted with needles, and containing a card firmly held in it with two pins, which pierce the card. This frame can be moved forward, so as to bring, in succession, five different portions of the card under the points of the needles; on each of these portions of the card a spectrum can be registered. By means of the screw-head at the side of the telescope, the pointer can be brought into coincidence with a line; a finger of the other hand is then pressed upon one of the needles at the end of the arm which traverses the card, and the position of the line is instantly recorded by a minute prick on the card. A bright line is distinguished from a dark line by pressing the finger on both needles, by which a second mark is made immediately below the other. In all cases the position of the line is registered by the same needle, the second needle being used to denote that the line recorded is a bright one. It was found that from ten to twelve Fraunhofer lines could be registered in about twelve seconds, and that when the same lines were recorded five times in succession on the same card, no sensible difference of position could be detected between the pricks registering the same line in the several spectra.

AMERICAN IRON.

H. Tudor Brownell, Esq., exhibited a specimen of iron from a new mine in northwestern Connecticut, twisted and bent cold, and a specimen of the ore, containing eight or nine per cent of titanium.

Mr. Thomas D. Stetson said that that was a region where very pure iron is found. Probably they would mix a variety of ores, as is usually done, to make steel.

The President.—There is no phosphorous in this iron, and no sulphur. The Secretary has tested it and finds that it is a very pure form of iron.

The Secretary—That bent piece shows remarkable ductility.

The President.—A small proportion of titanium benefits steel if it can be retained, and patents have been taken out for processes for retaining it. Hematite contains about seventy per cent of iron, and is, therefore, richer in iron than the ore from which this specimen is made.

Mr. Stetson.—American manufacturers of steel labor under the disadvantage of being young. The British manufacturers have a practice and experience of fifty or one hundred years; and they are able to guarantee a uniform quality of steel. In working at nail-making, cutting all the time upon cold iron, three clips a minute, we have a chance to know the quality of our steel very soon; but in making cutlery it may be months before we hear from it. If I wished to invest in steel manufacture, I would try the steel in a business like nail-making, which would give it a severe test in a short time. When I worked at nail-making, we found some of our American steel, from the Adirondac works, and which came from the neighborhood of this mine, decidedly better than the Sheffield steel; but probably the next lot would work very differently. I would not say it was not as good, but we want the bars of different lots to run alike. Our young steel manufacturers must learn to make a uniform quality of steel, and then sell it at a low rate for a number of years to compete with the imported, before the public will believe it is uniform. I believe that, with the aid of a moderate tariff, we can make steel to compete with the English steel, not so much from opening new mines, as from learning how to make it of a reliable grade and quality.

Mr. Weir.—Pure native iron is not often found; but it has been found of a thickness of about two inches in Litchfield county, Conn. That is a region of very pure iron. It is where the Salisbury iron comes from. It is where the Ames works and the Adirondac works get their iron. It is good tough iron, but rather soft. It would be rather a disadvantage to have the iron in a pure state more than two inches thick.

The President.—A vein of pure iron two feet thick would be of no value, because it could not be worked.

Dr. H. D. Sheppard stated that in the burning of an iron store in New York, the iron had melted together so that it could not be worked, and as the best means to get rid of it, they dug a hole in the earth and let it down, and there it is to-day.

MOMENTUM MOTOR FOR SEWING MACHINES.

Dr. William Z. W. Chapman read the following paper:

The sewing machine is a very valuable invention, and produces wonderful results; but while with it woman can do much, the serious question arises whether, as it is used at present, she does not receive more physical injury than all its kind offices can ever compensate for. It is generally admitted that this worthy household machine is undermining the health of the women that use it. Indeed, it is acknowledged by responsible parties in the sewing machine interest, that it does injure women, and one person prominently connected with sewing machine companies, who is, no doubt, capable of judging, states that he believes nineteen-twentieths of all the female operators are being ruined in health, and says that the sewing machine companies know it, but will not acknowledge this to the public, as they would then be compelled to furnish a motive power with each machine, or lose their sales. Hospital reports confirm these opinions, and physicians frequently interdict its use in families.

Now please consider for a moment, that while a woman operates that machine by the use of one or both of the lower limbs, especially in a sitting posture, there is great friction produced at the articulation of the thigh joint, disturbing the synovial fluid and exhausting it, thereby causing irritation and inflammation in those parts, which soon spreads throughout the pelvic viscera, affecting the uterus, the spinal column, and ultimately the brain, resulting often in insanity, as proved by medical reports. These statements may seem strong, but they are stubborn facts, which it becomes every husband and father to seriously consider.

But while the sewing machine men acknowledge to individuals its baneful effect upon women, and say a good motor is greatly needed, they also say, that while they can sell all the machines manufactured, it is not to their interest to state these facts to the public, or in any way to encourage the introduction of a sewing machine motor, however complete and effective it may be.

Being thoroughly convinced that a practical sewing machine motor was needed, my thought and labor have been bestowed upon the subject for some years, hoping to produce a cheap, convenient and effective remedial agent, for woman. Before making my present machine, it was found by experiment and investigation, that the desideratum was not obtainable by the use of any of the known powers as at present applied. Springs, weights, electro-magnetic forces and other agents, were well considered but abandoned.

The sewing machine accelerated motor before you is compact, all its parts being within a cubic foot of space. There is no treadle, and the feet of the operator have nothing whatever to do. The driving power is obtained by the movement of a crank, which may be placed at either end. This crank is only turned occasionally, and the speed and duration of running depend upon how it is turned. The motor will run one hour, doing work requiring only from three to five minutes labor, at the crank, and the time spent in moving it is equally distributed throughout the hour, there being but a few seconds needed at each operation. This motion at the crank is a healthful exercise, and really takes but little more time than is usually given at starting and stopping, by taking hold of the fly-wheel. The motor is perfectly under the control of the operator. It has two positive rates of speed, fast and slow, and either can be used instantly, as required, a little management giving other rates of speed. A machine, by the use of this motor, can be easily driven at a speed of from 800 to 1,200 stitches per minute. It always starts the sewing machine in the right direction and cannot be reversed unless desired. The sewing machine can be started and stopped in an instant, right on a stitch, which is often very important. Sewing machine experts and mechanics have examined this motor, and acknowledge it the most practicable one they have ever seen, and confess that when it is put on sale before the public, the sewing machine companies will be compelled to adopt it.

Dr. Chapman exhibited and explained his invention illustrating the different rates of speed, and the facility with which it could be started and stopped. There is a fly-wheel, about nine inches in diameter, and weighing about fourteen pounds, which is set in motion by turning a crank. Giving the crank five or six turns it will run about three minutes at the rate of 600 or 800 stiches per minute; then, as soon as it begins to run too slowly, the operator, without stopping the work, turns the crank again. With the ordinary treadle, power is lost in stopping the fly-wheel, or checking it at the end of a seam, or in turning the work, crossing other seams, etc.; but in using this motor the motion of the needle is reduced or stopped, and the fly-wheel continues to run, ready to start the needle instantly. The apparatus occupies about one cubic foot of space, and may be attached with equal facility to any sewing machine. The motor can be retailed for twenty-five to thirty dollars. When desired, a treadle can be attached to the accelerated motor, enabling the operator to use either the treadle or the crank at pleasure.

The President.—We have frequently had before us the desirability of some plan for relieving women from the labor of running the sewing machine with the foot, but nothing heretofore presented has seemed feasible. This invention enables the operator, who in fact is the motor, to rest, applying the power at short intervals, by means of the hand, and yet to keep the machine in motion all the time. The objection to the machine moved by a spring is that, after it is wound up, the power is variable. The machine runs slower and slower until it is wound up again.

Mr. T. D. Stetson commended the practical manner in which the inventor had exhibited his machine and explained its use.

NEW BANK LOCK.

Mr. Thomas B. Worrell of Pennsylvania, exhibited a new combination bank lock, which was explained by Mr. O. M. Tinkham, and illustrated by drawings on the black-board. The outside of the lock has two knobs or handles, the larger being set to any given position by a circle graduated to 300 divisions. In the interior of the lock are four wheels, each capable of 1,380 positions (having forty-six teeth, and set by a pinion with ten teeth moved by the graduated handle), affording, therefore, more than three millions of millions of changes. The pinion is connected separately with the four wheels and with the ratchet which moves the bolts by the smaller knob. As the bolts cannot be open unless all four wheels are in exact position, and it cannot be known on trial which is out of position or whether any one or more are in position, and as it cannot be known except by trial of the bolts whether the wheels are all in position or not, there is no chance to "feel," and no mitigation of the full number of trials to be made. Yet the lock may be closed in an instant; and in case the lock is to be closed for a short time only, as in a safe during office hours, one wheel only need be thrown out of position in locking, so that it may be opened in five or six seconds with a knowledge of the mode of locking, and yet a person not knowing that it was so locked would probably disarrange the other wheels, involving all the changes. The combination can be easily changed, by changing the position of a screw in one or more of the four wheels.

The President regarded this lock as a great advance upon anything before produced. It seemed absolutely impossible to pick it, or to explode it.

BOAT DETACHING APPARATUS.

Mr. D. L. Cohen, from Florida, exhibited a model of his apparatus, by which, when the boat is lowered sufficiently near the water, both ends may be detached at once from the davits, and it drops square upon the water.

THE MANUFACTURE OF PAPER.

Mr. Thomas D. Stetson gave an account of the history of the manufacture of paper. The origin of the manufacture of paper is lost in antiquity. The Chinese made it a great many years ago. Joseph Amru is said to have brought it to Mecca about the year 906, from some point further east; and ever since, the world has possessed it. It is supposed that that paper was about the same as the Chinese make to-day, flimsy, soft, but nevertheless paper. If you take a quantity of rags and lint, and wet them, and roll them together, you will get a kind of felting action; and if you macerate it in water just enough to make the fibers about one-tenth of an inch long and sufficiently fine, and then let it dry, you will have a product that differs from the soft rags and lint. If you pulp rags and grind them and work them in water to a certain point, and it is still leathery and soft, it is still rag; but work it longer, and let it felt and harden, with or without pressure, it will produce a metallic or wooden sound, it has a ring in it that you cannot get from mere rags.

He would not undertake to philosophise so far as to tell you exactly why. The great essential condition of an invention, in doing a thing, is to know how to do it again. It is said that a lady once in Attleborough, Mass., took some charcoal and lard and rubbed them together and made diamonds; very small, but genuine diamonds. But she could not do it again. That was an accidental discovery that did not amount to anything. But when you have something that you can do again, no matter whether you understand it or not, that is something practical. The discovery of gunpowder was completed hundreds of years ago; and yet people are still discussing about the theory.

Paper has been known ever since the tenth century. We are now progressing very rapidly, not so much in the manufacture of better paper, as in the ability to manufacture it from different materials. We consume it very fast; and instead of being obliged to save it to make it over, we want to be able to use it for kindling or to waste it generally and employ our time in some special branch of business. We want to plunge straight along; not to fritter away our time in trying to save paper, but use it up, and let them make more. That is business; that is "go ahead."

We need new accessions of paper-working materials. There are not rags enough; and there are difficulties attending the use of other materials. The manufacture of paper from wood has become more successful within a few years, because they have learned to dissolve the lignin, or the matter that surrounds the tenth-of-an-inch fibers that they want for paper. There was a process patented by Mr. Lyman of this city, and largely used, which it was thought would do the whole business. He filled the wood full of steam at a high pressure, and then suddenly removed the external pressure. The result was that the steam in the pores of the wood tore it to pieces, with an explosion like that of a gun; and it produced a very fine furzy stuff which they thought was just in the right condition to make good paper. But it was not. It was necessary to dissolve away about sixty-five per cent of it, consisting of an interstitial or intercellulose matter, which is not suitable for making paper; and then the remaining thirty-five per cent could be used for making paper.

The difficulty is to get the woody fiber in the right condition. It is found that by boiling it for a certain time in alkali of a certain strength and of a certain temperature, this useless matter can be dissolved. Straw seems to require a little weaker alkali in its treatment. It is found to be a very nice operation to perform; for the alkali must be at 2° or 3° Baumé, and the temperature must not exceed 300° or 310°. It is necessary in the manufacture of paper, as it is in the manufacture of steel, to mix the stock to obtain the required quality. This is very different from mixing in substances foreign to the paper. If clay is put in, it does not add to the paper fiber, although it makes the paper heavier. But in mixing different kinds of stock it is all paper fiber. We are now using, very largely, wood chipped or split up by this fibering process, which does and does well in a moment what it would take days or weeks to do by ordinary mechanical means, and prepare the material for the action of the chemical solvent. This is one of those cases in which it is difficult to tell where chemistry begins and where mechanics leave off. Soaking in water is really a chemical operation, and when we treat the wood in this manner we make a pulp which we could not make by ordinary mechanical means. But certainly when we dissolve or take away two-thirds of the material, chemistry may claim to have done more than it ever had done before in the manufacture of paper.

In South America, and in places where cigarettes are largely used, they want a paper which will not, in burning, produce an offensive oil; and there has been a good deal of effort to make paper from tobacco.

Several patents for such paper has been obtained by Americans. This paper [producing a sample] was made from pure tobacco, or else from tobacco with a certain proportion of manilla. Tobacco can be so treated as to work all the tobacco properties out of it. But this retains much of the strength of the tobacco. It is an herb and possesses very little wood property. A large quantity of this paper is made chiefly from the stems, a few leaves being required. There is a patent on the material from tobacco alone, a patent on the process of making it from tobacco alone, and a patent on the process of making it with a certain quality of manilla, which is found to be a very innocent ingredient. Most other ingredients which have been tried produce more or less oil in burning, which oil is deleterious.

Different substances produce paper of different qualities. If paper is made from flax, it possesses a flaxy cellulose structure. If it is made from linen, it is very strong; but for most purposes cotton paper is the best. Prof. Mapes used to insist that there was a difference in the chemical elements under different conditions, a difference in the original primary principles under certain organizations; but generally we do not like to accept that theory. We prefer to say that there are mixtures of other things which cause differences in the mechanical effects. But it matters not now what is the cause; we know there is a difference in the condition of these little fibers a tenth of an inch long. If we want to make strong paper for bank notes, we take a proper material; and so, by varying the materials, and by mixtures of different materials, we know how to make the article we want.

One of the contributions to novel materials for manufacturing paper within a few years is galega, an herb not much known to science, simply known as a weed, the use of which for paper has been patented by Messrs. Gillet, Dubois & Boissonneau. This paper has no peculiar property; it is about the same as other paper. We can use either the large stalks or the fine leaves, and with proper treatment can obtain a very good paper material. It can be raised a ton or two to the acre, the same as grass. It makes a very good stock for coarse papers; but there are some difficulties in bleaching it, so that it cannot yet be used for fine paper.

Now we come to the material which is more useful than any of the others, and which is likely to be for a long time to come, a material you are all familiar with, the cotton plant, the "king" a few years ago, and a very important element in modern industry. Mr. S. proposed to make no special remarks on the importance of cotton, politically or commercially to our country; but he might say that we have an immense, and the only large, area of country adapted in climate, moisture and soil, for the production of cotton. We have four times the area of all the rest of the world adapted for raising this great staple, and we can supply the world with cotton.

In preparing cotton we gin off from the seeds all the long fiber we can get. But the seed is still covered with a fur. Leaving the greater proportion of the cotton which is pulled off from the seed, to be spun and woven with cloth, worn into rags, and made into paper, as heretofore, we will turn our attention to this other portion of cotton left on the seed. There is a large mill in England, the Sankie mills, between Liverpool and Lancaster, where they are treating, in a very large way, this coated cotton seed. They have patented their new process, both in England and in this country, and they propose to entirely revolutionize the cotton manufacture, with regard to the utilization of this fiber remaining in the seed.

At present the cotton is ginned upon the plantations, by unskilled labor, and in an unskilled manner. Some of the cotton is torn, some is cut, some is dirty, and the whole is attended with a large expense. They propose to pack the cotton with the seed. When Cuffie picks it out of the pod upon the plantation, he shoves it into a bag; and then instead of ginning it and pressing it into the bales of pure cotton, it is proposed to press it to a less degree and send it, seed and all, to Boston, New York, Lowell, Manchester, or, if more convenient, to some location near the plantation, like Charleston or Mobile, and there to have it ginned in large quantities by skillful mechanics who understand it, and can do it economically; and then the seed will be ready for treatment. At present the inventor is laboring under the disadvantage that is necessary to take special pains to obtain the seed which is usually thrown away, or used for manure upon the plantations; and they must pack it in boxes or barrels and transport it to England before it can be subjected to the treatment I now propose to describe.

The problem how to get that cotton off so as to make it pay, is the same, only a good deal finer, which Eli Whitney met in 1792 in the invention of the cotton gin. He met it by fixing saws upon a cylinder, the teeth passing through a grating upon which the cotton was placed, and dragging the cotton through, but the grating being too fine for the seeds to pass through. When the seeds had been treated long enough in that way, they were dropped out. The problem is to utilize all that is valuable in the seed that has been so treated. On the outside of the seed there is cotton that has not been removed, On the inside there is a mealy substance, and in the meal there is oil. Now if that is put under a press, the oil may be pressed out of the meal; but here is the thirsty cotton ready to soak up so much of it, that what is left does not pay for the operation. Messrs. Rose & Gibson, crack the seed and knock the meal out. They press the meal and get the oil out, as linseed oil is obtained, and afterward use the cake in the same way for feeding cattle, or feeding man; for that is one of the suggestions that they make, that it will be valuable for human food.

Next they want to get the cotton from the husks. First they boil them for a certain length of time in alkali, and then beat them in water. [Mr. S. here drew upon the blackboard and explained the apparatus for removing the cotton fiber, resembling the ordinary rag machine of a paper mill, the husks passing through a strainer.] They have now separated the cotton from the husks; but it is found to be too long still for paper, and they grind it as rags are ground. The only waste product is the partially dissolved husks, for which they have as yet found no use.

One word before concluding, upon another use for paper which has not reached a high commercial success. There have been difficulties in making it waterproof. The manufacture of a waterproof paper carpeting to take the place of oil-cloth, was commenced in a large way. It was supposed that by saturating the paper with a proper material, and then drying it, it would be absolutely waterproof; but it is found that the thorough soaking floors often get will sometimes start it. It is a very promising article; but in order that it should take the place of oil-cloth, it should be infallibly waterproof, and in some cases the oil-cloth paper has not stood that severe test.

Adjourned.

PROCEEDINGS

OF THE

PHOTOGRAPHICAL SECTION

OF THE

AMERICAN INSTITUTE.

May 3, 1870.

Charles W. Hull, Esq., in the Chair; Mr. Oscar G. Mason, Secretary.

Mr. A. J. Newton exhibited negatives made by M. Carey Lea's colodio-chloride process, also other negatives made by the tea process, which he had described at a previous meeting of the Section.

Mr. Newton stated that he had never been able to produce satisfactory negatives by alkaline development, without intensifying afterward. In making the negatives which he exhibited, the exposure in the camera had been forty seconds in each case; and, by comparison, some judgment could be formed in regard to the relative value of the two methods used. After several trials, he found it impossible to produce negatives from the glass positives so made, the shadows and delicate details of the positive being entirely obliterated upon exposure in contact with another plate so prepared, producing a harsh, worthless negative impression. This result he attributed to some obscure chemical influence, which was brought into action by the contact of the two films.

Mr. O. G. Mason suggested the possibility of the effect being produced by insufficient fixing or working of the positive print, which would thus admit of further chemical action of light while being exposed for producing the negative impression.

Mr. H. T. Anthony thought that the cause of change would be found to exist in the positive alone, without any regard to the contact of the two films, for, being in a dry state, they would not produce chemical action.

Mr. D. C. Chapman remarked that he had never had any difficulty in producing brilliant negatives with an alkaline developer in the colodio-bromide process, and exhibited prints from two negatives, one of which had been exposed thirty seconds, and the other four minutes; showing the great facility with which the desired effect could be produced and modified by the developer alone.

Mr. H. J. Newton also exhibited several very good positives printed on glass by the following process: The plates were first flowed with a solution of one part albumen, and six parts of water; then carefully dried at a high temperature, which he found to be a necessary condition for success; for plates which were dried at the ordinary temperature of the work-room were very imperfect, in fact worthless; after this substratum of albumen was thoroughly dried, the plates were flowed with colodio-chloride, dried by heat, and printed by contact. He found that the transparencies could be strengthened and rendered more brilliant when desired, by the use of a one grain pyrogalic acid solution, with eight or ten grains of silver, and were easily toned by the ordinary gold toning solutions.

Mr. Anthony expressed pleasure in examining the proofs which had been offered, demonstrating the successful application of the colodio-bromide process for duplicating prints, on glass; and hoped that further experiments would be made for the production of negatives, as well as positives.

Mr. Mason exhibited several samples of silver crystals, which had been exposed to, and dried in bright sunlight immediately after removal from the mother liquor in which they had been formed. In every case the light had produced a decided change in the color of the crystals.

Mr. Chapman presented twelve prints of the sun mounted on one sheet, showing the progress of several large spots across the entire disk of the luminary. He stated that by careful measurements with the Rutherford micrometer, he had found one of these vast cavities in the photosphere of the sun, was seventy thousand miles in diameter; that these spots are only cavities, was plainly shown by the varying forms which they assumed during the days succeeding those on which the photographs were taken.

Mr. Wm. Kurtz read extracts from a letter which he had received from Dr. H. Vogle of Berlin, Prussia, relative to his contemplated visit, upon the invitation which he had been pleased to accept.

The following committee was then appointed to receive and welcome Dr. Vogel upon his arrival in New York: Prof. Chas. A. Joy, Prof. S. D. Tillman, Messrs. H. T. Anthony, Wm. Kurtz and P. F. Wiel.

June 1, 1870.

Mr. Henry J. Newton in the chair; Mr. Oscar G. Mason, Secretary.

Mr. O. G. Mason exhibited a photographic print, made some eleven years ago, which had been protected from atmospheric influences by a coating of gum on both front and back. He also exhibited prints made by the American Photo-Lithographic Company, which were much admired and highly spoken of by several members. The prints were good illustrations of the great utility of the process in the reproduction of reduced or enlarged copies of engraved or printed matter.

Mr. D. C. Chapman exhibited a very efficient actinometer, which he had constructed by placing a series of half size (four and one-quarter by five and one-half inch) porcelain plates standing on one end, edge to edge, and having drawn on them a scale of broad black lines and figures. Projecting from one end, at right angles with the bar supporting the scale of plates, was a bar about twelve inches in length, supporting an ordinary gas burner, the flame from which illuminated the plates in decreasing ratio, in accordance with the well known law of dispersion with increase of distance. The relative sensitiveness of chemicals under examination was readily determined by the amount of the scale rendered visible.

Mr. John B. Gardner said he had for a long time made a very sensitive collodion, by the use of alcohol from which the water had been absorbed by the introduction of carbonate of soda. He gave his formula as follows:

20 oz. collodion,
60 grs. iodide of cadmium,
20 " iodide of ammonium,
20 " bromide of ammonium.

Dissolve the cadmium iodide in the collodion; the ammonium salts in water, and filter it into the collodion, after the first named has been dissolved. Finally add 100 grains carbonate of soda, agitate it thoroughly, allow the carbonate to settle and then decant.

One-third of this collodion added to a collodion like the above, only leaving out the carbonate, will increase the sensitiveness and enable one to work with a less acid bath than could be used otherwise with success.

Mr. Boyle stated that he had some years ago made a very sensitive collodion by the use of raw-hide or skin, instead of cotton, after a similar treatment with mixed nitric and sulphuric acids.

After a discussion on these processes the society adjourned.

July 5, 1870.

Mr. Henry J. Newton in the chair; Mr. O. G. Mason, Secretary.

Mr. C. Wager Hull read extracts from a letter which he had received from Mr. M. Carey Lea of Philadelphia, who had learned from the printed transactions of the Section, that Mr. Newton had found some trouble in developing the image on colodio-bromide plates, which Mr. Lea believes to have been caused by using a bad sample of cotton.

In further explanation of his experiments with colodio-bromide plates, Mr. H. G. Newton stated that he had procured the cotton from the Philadelphia manufacturer recommended by Mr. Lea, and had taken especial care to follow the formula given, in its minutest detail.

Mr. Newton had produced very fine results by the use of five grains of carbolic acid in each of his silver solutions for printing.

In discussing the keeping of paper, Mr. Hull spoke of the great advantages derived from the use of a chloride of calcium box, in which to store sensitized paper. A tightly closing box, with a perforated covered tray at the bottom, in which chloride of calcium, or ordinary air slacked lime, was placed, had enabled him to keep silvered paper in good condition six or eight days.

Mr. J. H. Hallenbeck stated that several large establishments, extensively engaged in printing for the trade, were now using the calcium box as described. Without some such device they would often be obliged to discard paper unused at the close of the day on which it was sensitized.

Mr. Atwood, the printer at Gurney's photographic establishment, said that he found it much more difficult to keep highly salted paper. He was constantly using, with great success, the printing formula given by Mr. Newton, as published in the *Philadelphia Photographer*, for April, 1870.

Mr. John B. Gardner advocated the use of one drop of chemically pure nitric acid in each ounce of the printing bath, which he kept at forty grains.

Mr. Hallenbeck recommended the use of equal quantities of bromide and iodide of silver in the negative bath. The bromide was prepared by precipitation and washing, like the iodide. He believed that a bath so prepared gave results far more harmonious, especially in dim light and heavy shadows.

Adjourned to the first Tuesday in October.

October 4, 1870.

Prof. S. D TILLMAN in the chair; Mr. H. T. ANTHONY, Secretary (*pro tem*).

Prof. Tillman introduced Prof. Henry Morton of Hoboken, N. J., who exhibited photographs of the solar flames or protuberances, taken with the spectroscope, by Prof. C. A. Young of Dartmouth College, Hanover N. H. Prof. Morton described the construction of the apparatus, and the method of using it for producing the negatives from which the prints exhibited were made, together with the following letter:

HANOVER, N. H., *Sept.* 28, 1870.

Prof. HENRY MORTON:

Dear Sir.—I write to tell you that this afternoon, with the help of Mr. N. O. Bly, our photographer, who has assisted me in the matter with great skill and interest, I have succeeded in obtaining photographs of protuberances on the sun's limb of which I inclose a specimen. They were made by attaching a small camera to the eye-piece of the telescope, and opening the slit somewhat widely. We worked through the hydrogen line near G.

As a picture, the little thing amounts to nothing, because the unsteadiness of the air, and the mal-adjustment of the polar axis of the equatorial caused the image to shift its place slightly during the long exposure of three and one-half minutes which was required, thus destroying all the details. Still the double-headed form of the prominence is evident, and the possibility of taking these photographs is established.

Success will depend upon the use of more sensitive chemicals (those used to-day were the same ordinarily employed for portraits), and a very careful adjustment of the equatorial axes and the clock-work; I fear a telescope of much larger aperture than mine will also be found necessary, in order to produce pictures that will really give much of the idea of the form and texture of these beautiful clouds * *. To-day, also, in examining a spot which reversed the hydrogen lines very finely, I observed on opening the slit that the phenomonen was caused by two enormous protuberances or luminous clouds, which, in the spectroscope, shone brightly even upon the surface of the sun; their form could be distinctly traced, and their extreme length was about four minutes of arc, or 111,000 miles * * *.

Truly yours,

C. A. YOUNG.

The chairman stated that Messrs. Hawkins & Wale had commenced the manufacture of very excellent pocket spectroscopes at Union Hill, N. J.

After considerable discussion on the methods now used for photographing a solar eclipse the Section adjourned.

December 6, 1870.

Prof. S. D. **Tillman** in the chair; Mr. O. G. **Mason**, Secretary.

Mr. Otto Loehr exhibited a very fine eight by ten reversible camera box, in the construction of which he had introduced a very important improvement in the method of keeping the plate-holder or sliding portion of the box parallel to the stationary or lense portion, and at a true right-angle with the axis of the lense, and yet admitting very easy movement in focusing.

Mr. Loehr's improvement consists of a brass groove on the edge of the box, into which are fitted small iron slides firmly attached to the lower corners of the sliding portion of the box, by which arrangment the parts are kept free from contact with the silver solution, which is so destructive to guides of the old form.

Mr. Henry Merz suggested the use of solid india-rubber corners, or that such portion of the plate-holder as was exposed to the action of the solution should be chemically prepared with some preservative compound, like paraffine or wax.

Mr. O. G. Mason spoke of the valuable repelling property which paraffine has for most solutions used by the photographer, and gave instances in which it had protected costly articles during several years of constant use. Wooden articles prepared by boiling paraffine would last much longer than similar articles not so prepared. The general use of paraffine in the preparation of plate-holders, wooden sinks, trays, etc., was an economy which should not be overlooked by the profession. He considered the use of solid rubber plate-holders or kit frames, as suggested by Mr. Merz, as important; he had proved their value by the constant use of a set of solid rubber kits during the past few years.

Mr. Wm. Kurtz called attention to the useless labor and expense of putting a glass bottle or reservoir in the lower part of the plate-holder, for the purpose of saving solution which flowed from the plates during exposure in the camera. He had used such a devise many months, but failed in all endeavors to get a drop of solution to enter it.

Mr. H. T. Anthony remarked that a western photographer had recently invented an ingenious device for retaining prepared paper in the lower part of the holder for absorbing the solution, on the plan practiced by some members of the Section. The device consisted in the peculiar form of the paper and a spring for retaining it in a proper position.

Mr. Henry Merz exhibited a very fine panoramic view of the city of St. Louis, Missouri, made by Mr. Robert Benecke, a photographer of that city. The picture was made on fine, fourteen by seventeen inch, plates, of such uniform appearance that the joinings of the several parts were hardly perceptible. The tone and careful manipulation were highly commended by the members present.

Mr. H. J. Newton called attention to the fine perspective of this picture ; and pointed out the necessity of having the cameras carefully leveled, in order that it might occupy the same plane while being rotated in order to take the several sections, otherwise the lines would not meet as perfectly as they did in the picture now exhibited.

Mr. O. G. Mason presented four six and one-half by eight and one-half photographs and eight stereographs of cases of disease at Bellevue and Charity hospitals, remarking, that he did not present them as fine results of photographic manipulation, but rather as interesting illustrations of the utility of photography, in representing various phases or stages of disease. As most of his work was done while the patient was suffering more or less pain, it was impossible to produce perfect pictures, on account of involuntary muscular action in the patient, which often destroyed all hope of producing fine effects in the more minute portions of the diseased parts under treatment.

Mr. H. T. Anthony proposed that members of the Section, should make few series of experiments in the preparation of more sensitive chemicals. Some years ago, he had produced very sensitive plates in a bath, prepared by adding pyrogallic acid to the ordinary nitrate solutions. Not having anything to guide him in determining the proper amount of pyrogallic acid to be used, he at first added an excess ; in consequence of which he found that the plates, would not develop upon the application of the iron developer in the dark. By admitting diffused light to the plate, while the developer remained on the film, the image flashed out immediately, but was so thin, that the fixing solution completely dissolved it. He then concluded to let the bath stand, until all the action that could be exerted by the pyrogallic acid upon the silver solution in the dark should be completed. The bath stood wholly secluded from actinic light, for at least one month. Upon trying it again, he obtained nothing but foggy pictures. The development would commence fairly, but would end by fogging badly all over the plates, so that the negatives were quite useless. As the fogging appeared to be due to the action of diffused light over the plate, he determined to test it by preparing a plate entirely in the dark. The result was a beautifully developed negative, with a very short exposure in the camera. He afterward found that an instantaneous exposure of one of these sensitive plates, to the light in which the ordinary plates were prepared, would cause a foggy picture. The apparent difficulties of working plates of such excessive sensitiveness in the ordinary operations of photography, were such that he had never taken time to revise his experiments, or to attempt any modification in the preparation of the bath, except by the substitution of gallic acid for pyrogallic. He found that worked very well, but it was not nearly so sensitive. To those following in the line of his experiments, he would recommend the addition, of not more than two grains of pyrogallic acid, to sixty ounces of silver solution.

Mr. John B. Gardner said he had produced a bath of more than ordinary sensitiveness, by reducing the nitrate of silver to carbonate, by means of carbonate of soda, and then dissolving the carbonate thus formed, in nitric acid, then adding cyanide of potassium, to render the solution neutral to test paper. In the use of a bath so prepared, he was able to reduce the time of exposure in the camera, to two-thirds of that required by the ordinary nitrate bath.

Mr. H. J. Newton did not consider cyanide of potassium a sure remedy for all unsatisfactory conditions of the nitrate solution. He would recommend its use in the preparation of all sensitizing solutions, only to such extent, however, as would leave the solution neutral, or nearly so. He thought that similar results might be obtained by sunning the solution before or after the addition of the cyanide of potassium, or by sunning the silver crystals.

Adjourned.

January 3, 1871.

Mr. H. T. ANTHONY in the chair; Mr. O. G. MASON, Secretary.

The committee on alkaline sensitizing baths reported progress.

Mr. T. G. Dimmers explained his method of neutralizing and regulating silver solutions for negative baths. Whenever the solution is found too acid it is placed in a evaporating dish, and heat is applied until it is raised to nearly the boiling point, when five or six drops of strong liquid ammonia is added for each gallon of solution, producing a brown precipitate, which gives the solution a muddy appearance The heat is then increased and the solution boiled until one-third of its amount has been evaporated, when a heavy black precipitate will be found on the bottom of the dish. Should this not be the result, the boiling must be continued until it appears. The amount of this precipitate will depend upon the work done by the bath, as it consists of organic matter and iodide of silver. After cooling, the solution is filtered and sufficient water added to make a stock solution, some five or ten grains stronger than the sensitizing bath is used. By the occasional addition of a few ounces of this, the working solution is kept neutral and up to standard strength. When the working bath has become considerably reduced, it may be mixed with an equal quantity of the stock solution, or a portion of it strengthened by the addition of crystalized nitrate of silver and treated with ammonia, as in the first instance. Mr. Dimmers uses nitric acid to correct alkalinity of the bath.

Mr. Gardner did not like the effects of ammonia, and if it was found beneficial as stated by Mr. Dimmers, he thought it important that the exact heat of the solution and time for adding the ammonia should be known.

Mr. James Taylor stated that he rectified the acidity of the negative bath by boiling after the addition of ammonia. A new bath, which worked well only a few days, was treated with ammonia and boiled (giving a dense precipitate solution in nitric acid); worked well after exposure to sunlight.

Mr. Roach recommended the use of nitrate of ammonia instead of the liquid form. He had worked successfully with it five years, in one bath, which had been kept up by additions of silver, and regulating in this way; he had added as much as eight grains to the ounce of solution, and would recommend the addition of three or four grains to the ounce in preparing a new bath.

Mr. Newton had precipitated silver as carbonate by carbonate of soda, then dissolved in nitric acid, and rendered it alkaline by addition of aqua ammonia. This solution, after three months' exposure to sunlight, was found quite acid. Another solution, exposed for the same length of time, and then kept an equal time in the dark, was found to be full of delicate needle-like crystals. Mr. Newton called attention to the great amount of carbonate of silver held in solution by the water used in washing the precipitate. This he recovered in the form of chloride by treating all his washing waters with chloride of sodium.

Mr. Gardner said he had met considerable difficulty in working a bath after being precipitated several times with bicarbonate of soda, which he could not get rid of; and he thought that ammonia was still more troublesome. He prepared to precipitate with carbonate of soda, and after washing the carbonate so formed on a filter, he dissolved in an excess of nitric acid, which excess was driven off by evaporation and fusing.

Mr. Mason believed that by the addition of so large a quantity of nitric acid to the carbonate, the organic matter with which the bath had become contaminated by use was redissolved, and therefore could not be removed by filtering, as it otherwise would be. He proposed to use only such quantity as would leave a small amount of carbonate undissolved. He had worked in this way many years, and always with success.

Mr. Anthony stated that by warming the silver solution when the carbonate was added, the conversion of nitrate to carbonate of silver was much more completely and easily made. He had added nitrate of ammonia. He had used it in his own practice, and given samples to friends, and contemplated introducing it to the trade; but some not meeting with success, he had been indirectly attacked by an article published in the journals, under the title of "Frauds of Stockdealers." He had made very fine printing baths by precipitating nitrate of silver by the addition of ammonia, and dissolving the carbonate thus formed in nitric acid, which was driven off by heat, and the solution made up to sixty grains to the ounce by addition of a proper quantity of water.

Mr. Newton exhibited a large series of very fine positives on glass, the negatives for which had been kindly loaned for the purpose by Messrs. Anthony, Howell, Gurney and Thomas. The plates had been prepared with colodio-chloride, and the impressions toned in a hyposulphite of soda and gol'd bath, as used for paper prints some years ago. The tone was very fine and presented great variety.

Mr. Gardner offered the following:

Resolved, That the members of the Photographical Section be and hereby are requested to supply the necessary apparatus for exhibiting negative and positive impressions on a screen, to illustrate chemical effects in photographic manipulations.

The resolution was unanimously adopted, and the following committee appointed to carry it into effect: H. T. Anthony, T. C. Roche, H. G. Newton, C. B. Boyle.

Adjourned.

February 7, 1871.

Mr. Henry J. Newton in the Chair; Mr. O. G. Mason, Secretary.

The Secretary reported a list of donations of photographs to the Section during the year 1870, all of which have been alluded to in previous reports.

Mr. H. T. Anthony, chairman of the committee on lantern illustration, reported that the committee had prepared apparatus and pictures, which were ready for exhibition in an adjoining room.

Mr. O. G. Mason called attention to the efforts being made for a renewal of the Woodward Solar Camera patent. He thought the original patent was granted upon unjust claims. Mr. Woodward did not invent the instrument, but merely adapted for photographic use, a device long and well known to men acquainted with optical science. A full account of it, by Sir David Brewster, with illustrations, had been given in a work published in Edinburgh, Scotland, as early as 1837. From one of the plates in that work he (Mr. Mason) had prepared a transparency which was here exhibited on the screen, showing its several parts and their relative positions.

Mr. T. C. Roche and his assistant then proceeded to the exhibition of a large number of glass positives, by the use of a very fine pair of lanterns manufactured and furnished for the occasion by Mr. Andrew Prosch. The pictures exhibited were in great variety, both of subject and methods of production. Many were from negatives made by Mr. Roche along the line of the Pacific railroad, and among the giant trees of the Yo-semite Valley. Most of the positives were made by various wet processes, and were remarkably clear; giving the finest details in both high lights and deep shadows, when magnified upon a screen which covered one end of the exhibition room. In contrast with these wet plate positives, some of Tenier's best albumen contact prints on glass, were shown on the screen, producing effects far inferior to the plates by Mr. Roche. Then followed a large number of colodio-chloride positive contact prints, by Mr. H. T. Newton, many of which produced very fine effects on the screen. One of the very beautiful peculiarities shown in some of these plates was a variety of pleasing tones which, in many cases, added much to the harmony of the subject, by giving it a delicate tint of blue, purple and green, or sepiæ, seldom seen in glass positives of sufficient intensity to show when magnified to such a degree on the screen. Mr. Newton stated that the various tints were produced by toning the positives in a bath of hyposulphite of soda and gold. A large number of positives owned by Mr. Charles B. Boyle were then exhibited and explained, showing the utility of photography in illustrating the principles of physical science.

Mr. H. T. Anthony exhibited several card prints, delineating the misfortunes of a traveler on snow shoes.

A vote of thanks was tendered to Messrs. Anthony, Newton, Boyle, Prosch, and Roche, for the preparation and exhibition of the large number of pictures shown during the evening.

Adjourned.

March 7, 1871.

Prof. S. D. Tillman, in the chair; Mr. O. G. Mason, Secretary.

Mr. H. J. Newton exhibited duplicate negatives and positives on glass, by the colodio-chloride contact printing process, to which he had alluded at a previous meeting; and commented on the importance of duplicating valuable negatives, thus reducing the liability to loss by breakage while printing in illustration of the utility of this method of preserving valuable original negatives. Mr. Newton called especial attention to some of the plates exhibited, which rendered all the fine details, and delicacy of light and shade seen in the originals, and which were so modified in intensity and color as to be far superior for printing paper positives. He gave the following receipt for the preparation of colodio-chloride.

Forty-five grains of crystallized nitrate of silver are ground with one-half drachm of water, in a clean porcelain or glass mortar until dissolved; then add two ounces of alcohol, and pour into an eight ounce bottle; next add forty-two grains of gun cotton or pyroxiline; and after shaking the mixture, add three ounces of sulphuric ether, a little at a time, thoroughly shaking after each addition; then, in a clean mortar, pulverize finely nine grains of chloride of copper, and twelve grains of citric acid, add one ounce of alcohol and stir the mixture until completely dissolved; then pour into this the silvered collodion, prepared as before described, a little at a time, agitating meanwhile; when all mixed return the whole to the eight ounce bottle, and it is ready for use.

Mr. Newton had experimented with deliquescent salts, but found them unsuitable, as they gave the colodio-chloride so proposed the peculiar property known as "sweating" while printing. He had also used chloride of tin, but had discontinued its use. The positives were toned in the ordinary bath of hyphosulphite and gold, in general use some years ago for paper prints.

Mr. Newton gave the following formula for a developer, which he had found as energetic as iron, and which produced very fine effects in copying engravings, as well as in portrait work:

Stock Solution.—No. 1. 6 grains of pyrogallic acid.
6 grains of tannin.

Stock Solution.—No. 2. Saturated solution of sulphate of copper, 4 oz.
Acetic acid (No. 8), 2 oz.

When about to develop, mix equal quantities of Nos. 1 and 2.

Mr. Peter F. Weil exhibited a series of stereographs of animals, in amusing attitudes and dress, from plates made under an ordinary sky-light.

Mr. O. G. Mason presented four prints from negatives made at Bellevue Hospital.

Mr. D. C. Chapman exhibited a large collection of photographs which he had obtained in Europe, during his recent visit. Several large prints of the city and bay of Naples, with Mount Vesuvius in the distance, were very fine. Among the stereographs, was a very interesting picture of the swinging chandelier, used by Gallileo, in studying the vibrations of the pendulum at Pisa; and others, of excavations at Pompeii. Also photographs of lava, thrown out of Mount Vesuvius, in the eruption of 1868, which lava, Mr. Chapman found to be yet very hot. He also exhibited several pictures of curiosities, belonging to ancient Rome. He remarked that he had been unable to find any true stereographs of the interior of St. Peter's church; those mounted and sold as such, were merely duplicate prints from single negatives. He found the standard of photography, very low in Italy; although there were a few worthy exceptions.

Adjourned.

April 4, 1871.

Mr. Henry J. Newton, in the chair; Mr. O. G. Mason, Secretary.

Mr. O. G. Mason made a verbal report of progress in his division of work, as one of the committee "On the preparation and preservation of silvered paper." He had kept paper unchanged since its preparation in March, 1870.

Mr. H. J. Newton exhibited a collection of very fine glass positives, made by the colodio-chloride process.

Mr. Peter F. Weil exhibited one dozen group and composition stereographs, made under ordinary gallery light. The novel arrangement, and pleasing effects produced in these pictures, were much admired by those present.

Mr. O. G. Mason presented six stereographs of cases photographed at Bellevue hospital, illustrating the effects of disease and its surgical treatment.

Mr. Wm. Kurtz exhibited and explained the working of a ingenious and convenient camera attachment, for producing vignette negatives. The device consisted of a bar or strip of wood, projecting from the lower part of the front of the camera box, and extending under its entire length, forming a sub-base. In the upper surface of this base or bar, extending along its entire length, were three grooves, in which three slender rods had a free motion and which was regulated by the operator while observing the image of the sitter on the focusing screen. To the ends of two of the rods, projecting in front of the box, was attached a light frame of wood, in such a manner, that the operator could, by advancing the slender rod in the right hand groove, turn it to an acute angle with the axis of the lens; and by the same means turn it to the left, by advancing the left hand rod; or the whole frame might be made to advance or recede, by the simultaneous action of both rods. In the frame, thus carried by the right and left hand rods, was hung another very light frame, covered with tissue paper, in which was a cut, or opening, of proper size and shape, to produce the desired vignette. This paper covered frame was hung, through the center of its two perpendicular sides, to short sliding guides, which could be moved up and down in grooves in the inner surface of the outside or larger frame, thus enabling the operator to elevate or depress the vignette opening to suit his purpose; while a modification of form and of effect of light was produced by inclining the top or bottom of the frame from perpendicular, by means of the light rod in the central groove of the sub-base, this rod being provided with several joints for that purpose.

Mr. Daniel C. Chapman, who was attached to the Sicily division of the United States Expedition for observing the recent total eclipse of the sun, read the following paper:

Photographing the Solar Eclipse of 1870.

The appropriation made by Congress, for the purpose of observing the total eclipse of the sun, to take place December 22d, 1870, and be visible in the south of Europe, was placed in the hands of Prof.

Pierce, of Cambridge, Mass., Superintendent of the U. S. Coast Survey. By him, the expedition was organized, and formed into two divisions; one party was to make observations in Spain, and the other in Sicily. To Prof. Winlock of Harvard College, Cambridge, Mass., was entrusted the arrangement of the details of the party going to Spain; while the arrangement of the photographic apparatus, including telescope, tent, etc., for the party going to Sicily, was placed in the hands of L. M. Rutherford, Esq., of New York. The principal thing to be obtained, was a suitable telescope with portable pier, equatorial and clockwork; after considerable difficulty, a telescope of six inch apperture was procured. This telescope required to be corrected for photographic use, in the same manner as Mr. Rutherford had previously corrected the thirteen-inch-object-glass, in his own observatory, to be used for celestial photography. This was accomplished by placing in front of the object-glass of the telescope, a flint glass lens of such curves as would shorten the focal length of the telescope, so as to be about one-seventh less than its usual length for vision. In the ordinary photographic cameras, the visual and chemical foci are made to coincide for the sake of convenience. Neither are in the best condition, one set of rays being over-corrected, and the other under-corrected; therefore, a telescope for vision is still more over-corrected for photography; that is, the focus of the actinic rays is outside of that of the luminous rays, and thus the rays are so dispersed, as not to produce a good focus at any point; but, by the addition of this lens, the focus of the actinic rays is shortened, and brought inside of the luminous focus, at a point where the greatest sharpness and rapidity of action is obtained. The camera box which was attached to the telescope, was of peculiar construction, A portrait lens of short focus was placed in a box of about thirty inches in length, in such a position as to copy the image made in the focus of the telescope, and enlarge it at the back end of the box.

By this arrangement we were enabled to expose plates in the focus of the telescope, and also in an enlarged portion at the back end of the box, without making any change, which would greatly facilitate our operations, for we intended to expose in the principal focus during totality, and in the enlarged portion during the partial phases. Our tent was twelve feet wide by sixteen feet long, and of sufficient height to accommodate the telescope, a portion of one side of the roof being made to roll up, and through which we were to work the instrument. In one corner, and under that part of the tent which did not open, was the chemical room, constructed of black muslin, and ventilated at the top. In the side of the chemical room near the telescope, a pocket was made, with a flap on each side, by means of which the plate holder could be passed in and out without admitting light into the room. I carried with me a complete set of photographic materials, cameras, etc., and even the water to make my bath with, so that I might not be dependent on anything there, except water to wash the plates with.

I sailed from New York on the third day of November, and, to my great delight, found on board the steamer a number of scientific gentlemen belonging to both divisions of the expedition, some on their way to Spain and others to Sicily. After a moderately quick and rather pleasant passage we arrived in Liverpool on November 14th. Here our instruments were reshipped by the way of Gibralter to Sicily. Prefering traveling by land, I went across the continent, and on my way fell in with Prof. Pierce and Mr. Schott of the United States Coast Survey, and in company with Mr. Schott went on to Sicily, in advance of others of the party.

On December 5th we arrived in Catania, the place decided upon as the base of observations. Our first business was to find a suitable spot on which to pitch our tent and set up the instruments. In this we were very fortunate, for the garden of the Benedictine Monastery, with the use of several rooms in the building, was tendered us by Prof. Sylvester, through the American consul. This garden contained several acres of ground, beautifully laid out and arranged with shade trees, orange groves, flower beds and ornamented walks. The place being protected on all sides by a high wall of solid masonry, it was all we could desire. A suitable locality was soon selected and in a few days we had everything in working order. About this time we were joined by Mr. Lockyer, Prof. Roscoe, and others of the English party of observation. Among this party I had the pleasure of again meeting our much esteemed friend and eminent photographer Dr. H. Vogel, of Berlin, Prussia. For several days prior to the eclipse we took photographs of the sun, so that the locality of any spots which might be passing the limb of the sun could be accurately determined, for the purpose of ascertaining whether they had any connection with the protuberances or the corona. The morning of the day of the eclipse was spent in a general preparation for the event. Mr. Lockyer proposed to signalize the first contact observed in the spectroscope, according to Prof. Young's method, which he did by the firing of a pistol, still there was no visible contact.

But the instant there was visible contact, our first negative was taken, which showed plainly that actual contact had taken place several seconds previous, and coinciding exactly with the time of contact given by the spectroscope, thus proving that photography is more reliable in some cases than the eye. We continued to take negatives at intervals, varying from one to fifteen minutes apart, until about fifteen minutes before totality; then we made preparation for the total phase. In addition to the telescope I had mounted a photographic camera, of about twelve inches focal length and three inches aperture, on the telescope immediately over the axis. By the rapid action of this camera I expected to get a more extended impression of the corona, in proportion to the sun's diameter. Four plates were prepared, three for the telescope, and one for the camera, and placed in the shields. Two plates were to have a very short exposure, one at the commencement, and one near the end of the totality, the object being to show the locality and shape of the protuberances on both sides of the sun. Two other plates were to be exposed for the corona, one in the telescope, the other in the camera. As the length of the total eclipse was only about one minute and a half we designed that at least one minute should be devoted to obtaining the corona alone; but in securing this most important part of the eclipse we were doomed to disappointment, at least so far as photography was concerned. About five minutes before totality, a cloud passed over, entirely excluding both sun and moon from view; but as the cloud was somewhat broken and was traveling quite rapidly, we hoped to get a glimpse of the total phase, if we could not obtain photographs. In this we were partially successful; the thicker portion of the cloud passed off in time to give us a view of a portion of totality for the brief space of four or five seconds; and in this time I was enabled to get a slight impression in the camera, but nothing through the telescope. However, to the eye, enough was visible to gratify our curiosity. In about five minutes after, the cloud passed away, giving us clear sky again. We then continued to make negatives, as before, until near the end of the eclipse, when the sky was again overcast which prevented our obtaining views of the last contact. On the two following days we made negatives of the sun, for the purpose of ascertaining whether there were any spots about to appear which were not visible on the day of the eclipse; but none were found. Notwithstanding our bad luck, we were glad to find that the other division of the United States observers which went to Spain was eminently successful, as shown by the full reports of its operations already published.

NEW HELIOSTAT.

After some discussion on the solar eclipse Mr. O. G. Mason exhibited and explained a new Heliostat constructed according to the plan devised by Lewis M. Rutherford Esq., who had so modified it as to adapt it to all latitudes.

Adjourned.

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